Aviation Week

Including Space Technology

June 8, 1959

Gulfstream Production Hits Stride

Doak VZ-4DA VTOL

PRESCRIPTION FOR WEIGHT CONTROL...

Voi-Shan weight/master hex nuts combine a considerable saving in weight together with a carefully engineered design that meets the needs of a wide range of industry requirements.

Well-known Voi-Shan superior quality control and production methods assure a consistent high reliability and effectiveness wherever weight/master is specified. Excess metal has been removed without loss of full performance.

weight/master hex nuts

Now in quantity production, in sizes 4-40 through 3/8-24, the **weight/master** hex nut is unequalled as a successful answer to weight control problems. The chart shows **weight/master** hex nuts and proposed MS part numbers. NAS part numbers will be announced shortly.

VS PART #	MS #	SIZE	WT LBS/100 PCS
VN 300-40	MS 21042-04	4-40	—
VN 300-62	MS 21042-06	6-32	.0654
VN 300-82	MS 21042-08	8-32	.0991
VN 300-02	MS 21042-3	10-32	.1440
VN 300-048	MS 21042-4	1/4-28	.2340
VN 300-054	MS 21042-5	5/16-24	.4180
VN 300-064	MS 21042-6	3/8-24	.5500

For information on these and other Voi-Shan fastening products write to:

VOI-SHAN

VOI-SHAN MANUFACTURING COMPANY
8463 Higuera Street, Culver City, California

Pardon our pride—but we're celebrating

50 years of "FIRSTS"

in the aviation industry!

1909

First pneumatic airplane tire, built by Goodyear to replace sled runners used by Wright brothers.

1959

First in aviation tire production and sales every year for half a century—on the *first* of America's finest jet-liners. More jets and prop-jets now in service land on Goodyear aircraft tires than on any other kind. In fact, there are more Goodyear tires, wheels and brakes in commercial aviation service than all other makes combined.

Other Famous "Firsts" by Goodyear Aviation Products

FIRST low-pressure pneumatic airplane tire—the Airwheel.

FIRST brake designed specifically for aircraft.

FIRST fully automatic system of ice detection and ice elimination for aircraft.

FIRST tubeless tires specified for commercial airliners.

FIRST successful self-sealing fuel tank.

FIRST complete line of nylon cord tires for high-speed aircraft.

—and the best is yet to come!

***NEW** **DYNAMOMETER**—capable of speeds to 500 mph—will qualify tires for the highest-performance aircraft of the foreseeable future.

***NEW** **FABRIC REINFORCED TIRES AND RETREADS.** Goodyear is now qualified to retread jet airliner tires to new tire specifications.

***NEW** **DURABOND BALANCING** assures lasting adhesion of balancing compound *inside* aviation tire, perfect balance *outside*.

***THE ABILITY TO ANTICIPATE** the ever-changing needs of America's airlines has been the main factor in Goodyear's 50 years of aviation achievement. Now—as the industry shifts to jet power—Goodyear stands ready to meet the challenge of longer ground distances, faster landings, higher loads. We're anticipating these needs now—developing still more Goodyear "firsts" for tomorrow and far into the future.*

Goodyear Aviation Products maintains the largest field service staff of its kind in the industry. These trained service representatives—strategically located throughout the nation—serve commercial airlines and commercial manufacturers wherever and whenever needed.

AVIATION PRODUCTS BY

GOODYEAR

Airwheel—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

8463 Higuera Street, Culver City, California

Doorway to space With man's metal messengers orbiting beyond the moon, man himself cannot be far behind. His thin-skinned carrier will contain myriad parts and assemblies, each with watch-like precision less tolerant of error than anything before.

Ex-Cell-O's corporate family specializes in this kind of accuracy. For more than 35 years Ex-Cell-O has contributed pioneering ideas, precise parts and assemblies—first to the aircraft industry and now the soaring rocket and missile field. If your program is on the threshold of the Doorway to Space, Ex-Cell-O design, development, and manufacturing may provide the key to the precision needed on the other side of the moon.

XLO EX-CELL-O FOR PRECISION

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

Aircraft Division

MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O AND ITS SUBSIDIARIES: BRYANT CHUCKING GRINDER CO., CADILLAC GAGE CO., MICHIGAN TOOL CO., SMITH BEARING CO.

59-35

AVIATION CALENDAR

June 16-19—National Summer Meeting, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif.

June 17—Eastern Meeting, Survival and Flight Equipment Assn., Floyd Bennett Naval Air Station, Brooklyn, N. Y.

June 18-20—15th Annual Meeting, Institute of Navigation, U. S. Merchant Marine Academy, Kings Point, L. I., N. Y.

June 22-26—Summer-Pacific General Meeting and Air Transportation Conference, American Institute of Electrical Engineers, Seattle, Wash.

June 23-25—33rd Meeting, Aviation Distributors and Manufacturers Assn., St. Francis Hotel, San Francisco, Calif.

June 24-26—Second National Symposium, Nuclear Industry Division, Instrument Society of America, Idaho Falls, Idaho.

June 29-July 1—Third National Convention on Military Electronics, Sheraton-Park Hotel, Washington, D. C. Sponsor: Institute of Radio Engineers' Professional Group on Military Electronics.

June 29-July 3—Summer Seminar on Plastics—Its Mechanical Properties, Design and Applications, Pennsylvania State University, University Park, Pa.

July 1-10—U. S. National Soaring Competition, Harris Hill, Elmira, N. Y.

July 4-8—All-Woman Transcontinental Air Race from Lawrence, Mass., to Spokane, Wash. For information: All-Woman Transcontinental Air Race, Inc., 2611 East Spring St., Long Beach 6, Calif.

July 16-17—Third biennial joint meeting, Radio Technical Commission for Aeronautics and Los Angeles Section of the Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

July 28-29—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Westward Hotel, Anchorage, Alaska.

July 30-31—Quarterly Regional Meeting,

(Continued on page 6)

AVIATION WEEK Including Space Technology

June 8, 1959
Vol. 70, No. 23

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y. Publication Offices, 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice President; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary. Officers of the Publications Division: Nelson L. Bond, President; Harry L. Waddell, Senior Vice President; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator.

Subscriptions are solicited only from persons who have a commercial or professional interest in aviation, including missiles and space technology. Position and company connection must be indicated on subscription order.

Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada $8 one year. All other countries, $20 one year.

Second class postage paid at Albany 1, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office.
©Copyright 1959 by McGraw-Hill Publishing Co., Inc. All rights reserved. Cable Address: "McGraw-Hill New York." Publications combined with AVIATION WEEK including SPACE TECHNOLOGY are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

Subscribers: Send correspondence and change of address to Fulfillment Manager, Aviation Week, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, including postal zone number. Enclose recent address label if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Aviation Week, Including Space Technology, 330 West 42nd Street, New York 36, N. Y.

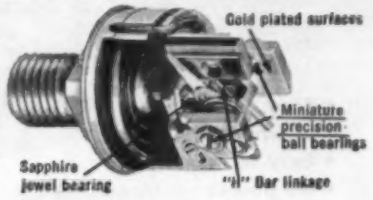
for performance in flight..... here's a little honey

FAIRCHILD'S NEW 1 INCH PRESSURE TRANSDUCER

...as small as a bumble bee, but can take shock, acceleration and vibration like no other pressure transducer its size. It was designed specifically for airborne instrumentation to meet the most stringent environmental requirements. Output signal resolution is less than 0.25% with single or dual wire wound potentiometer pick-off.

The excellent performance under environmental conditions is due to an improved "H" bar linkage between the diaphragm push rod and the potentiometer wiper arm which permits the moveable parts to be statically and dynamically in balance under various vibrations and accelerations.

Fairchild's line of Pressure Transducers include bourdon tube and capsular diaphragm types for measuring pressures from 1 to 10,000 psi, absolute, gauge, or differential. Standard units have pot pick-offs; a.c. type pick-offs available on special order.



SPECIFICATIONS AND CHARACTERISTICS			
Vibration	10 to 55 cps, 0.1" da; 55 to 2,000 cps 15g. Error less than 1%. Will withstand 25g, 10 to 2,000 cps.	Pressure Range	0-5 psi to 0-250 psi a, g or d.
Acceleration	40g in 3 planes; error less than 1%. Withstands 75g.	Linearity	±1.0%
Shock	50g without damage or permanent calibration shift.	Size (Volume)	¾ cubic inch (1" dia x 1" long)
		Temperature	—54°C to +100°C. Error less than 1% for most ranges.

For more information write Fairchild Controls Corporation, Dept. 23Y.

RELIABILITY INSIDE THE BLACK BOX

FAIRCHILD CONTROLS CORPORATION

COMPONENTS DIVISION

225 Park Avenue, Hicksville, L. I., N. Y.
6111 E. Washington Blvd., Los Angeles, Cal.

what can you do with this versatile

FLUID HANDLING HARDWARE?

H_2O_2 NOZZLE and ADAPTER Model QD-7

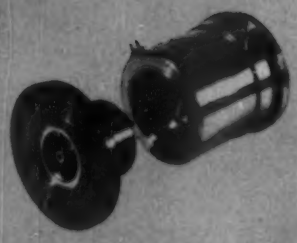
Fast, safe, easy servicing of aircraft and missiles. Adaptable for other fluids.

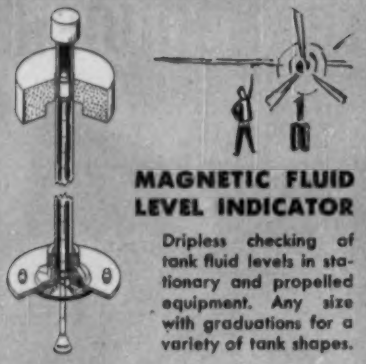
- Self-sealing
- Lightweight
- Working parts isolated from fluid
- Nozzle must be locked to adapter to actuate internal valves
- Sizes: 1½" to 8" I.D.
- 50 to 1,500 gpm.

QUICK DISCONNECT Model QD-2

For mercury-cooled nuclear power plants or conventional systems. Can be modified for remote operations and a wide range of fluids, gases or liquid metals.

- "Push-to-lock", "pull-to-open"
- Both halves self-sealing
- Can't disconnect during flow operations
- Proof pressure — 300 psi.
- Sizes: ½" to 6" I.D.





MAGNETIC FLUID LEVEL INDICATOR

Dripless checking of tank fluid levels in stationary and propelled equipment. Any size with graduations for a variety of tank shapes.

- Easy, under-the-tank check
- Lightweight
- Easy to install
- No power requirements
- No complex hidden linkages

FLOAT SWITCH Model FS-2

Operates electrically actuated valves and indicator lights. For aircraft and missile fluid systems.

- Enclosed switch mechanism
- Weighs only 10 ozs.
- 7 amps inductive load at 28 volts
- Highly-efficient where fluid levels change rapidly

FREE CATALOG . . . simply request on your letterhead. Illustrates complete facilities for development and manufacture of systems and components for fluid transfer, airborne suspension, nuclear and other applications. Includes details on line of military and industry approved products.

Flight Refueling, Inc.

FRIENDSHIP INTERNATIONAL AIRPORT • BALTIMORE 3, MD

West Coast Representative: William E. Davis, P. O. Box 642, Inglewood, Calif.

AVIATION CALENDAR

(*Continued from page 5*)

Assn. of Local Transport Airlines, Fairbanks, Alaska.

July 30-31—Sixth Annual Symposium on Computers and Data Processing, Denver Research Institute, Stanley Hotel, Estes Park, Colo.

Aug. 4-5—Second Annual Western Regional Meeting, American Astronautical Society, Ambassador Hotel, Los Angeles, Calif.

Aug. 5-7—William Frederick Durand Centennial Conference on the problems of hypersonic and space flight, Stanford University, Stanford, Calif.

Aug. 17—First National Ultrasonics Symposium, Institute of Radio Engineers' Professional Group on Ultrasonics Engineering, Stanford University, Stanford, Calif.

Aug. 18-21—Western Electronic Show & Convention, Institute of Radio Engineers, Cow Palace, San Francisco, Calif.

Aug. 24-26—Gas Dynamics Symposium, American Rocket Society, Northwestern University, Evanston, Ill.

Aug. 24-26—Institute of the Aeronautical Sciences' National Specialists Meeting, a symposium on anti-submarine warfare, (classified), San Diego, Calif.

Aug. 27-28—International Commonwealth Spaceflight Symposium, Church House, Westminster, London, England.

Aug. 31-Sept. 5—10th Annual Congress, International Astronautical Federation, Church House, Westminster, London.

Sept. 1-2—Conference on physical chemistry in aerodynamic and space flight, University of Pennsylvania, Philadelphia, Pa. Sponsors: Air Force Office of Scientific Research and General Electric Co.'s Missile and Space Vehicle Dept.

Sept. 2-4—1959 Cryogenic Engineering Conference, University of California, Berkeley, Calif.

Sept. 3-6—National Convention and Aerospace Panorama, Air Force Assn., Exhibition Hall, Miami Beach, Fla.

Sept. 7-13—1959 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 9-11—Sixth Midwestern Conference on Fluid and Solid Mechanics, University of Texas, Austin, Tex. Sponsors: AFOSR/Directorate of Aeronautical Sciences; Office of Naval Research; National Science Foundation. Dr. M. J. Thompson, Chairman, Department of Aeronautical Engineering, University of Texas.

Sept. 23-24—Engine and Operations Symposium, Airwork Corp., Millville, N. J.

Sept. 24-25—Solid Propellants Conference, American Rocket Society, Princeton University, Princeton, N. J.

Sept. 28-30—1959 National Symposium on Telemetering, Civic Auditorium and Whitcomb Hotel, San Francisco, Calif. Sponsor: Institute of Radio Engineers' Professional Group on Space Electronics & Telemetry.

Oct. 5-10—National Aeronautic Meeting, Society of Automotive Engineers, the Ambassador, Los Angeles, Calif.

Oct. 6-8—12th Annual Meeting, National Business Aircraft Assn., Hotel Leamington, Minneapolis, Minn.

Oct. 12-16—15th General Convention of the International Air Transport Assn., Tokyo, Japan.

Motor actuated

...at -425° F

Hydromatics *FLO·BALL* valves

Hydromatics makes them all . . . missile borne and ground support! These motor-operated FLO•BALL valves offer the optimum combination of 100% flow efficiency, perfect sealing, positive on-off and high speed response as fast as 200 millisec.

For airborne applications, these valves offer extreme compactness and light weight. In sizes from ¼" to 1", for pressures up to 4,000 psi, and temperatures to —425° F.

For ground support, motor-operated FLO•BALL valves up to 8" afford great system simplification and throttling ability . . . for temperatures as low as —425° F and pressures up to 3,000 psi.

Write for complete information on Hydromatics FLO•BALL valves . . . motor, pressure, or manually actuated . . . for high pressure, cryogenic, and corrosive applications.

Hydromatics, Inc.

LIVINGSTON, N. J. • WYMAN 2-4900 / LOS ANGELES, CAL. • DIAMOND 6-6900

FLO· BALL

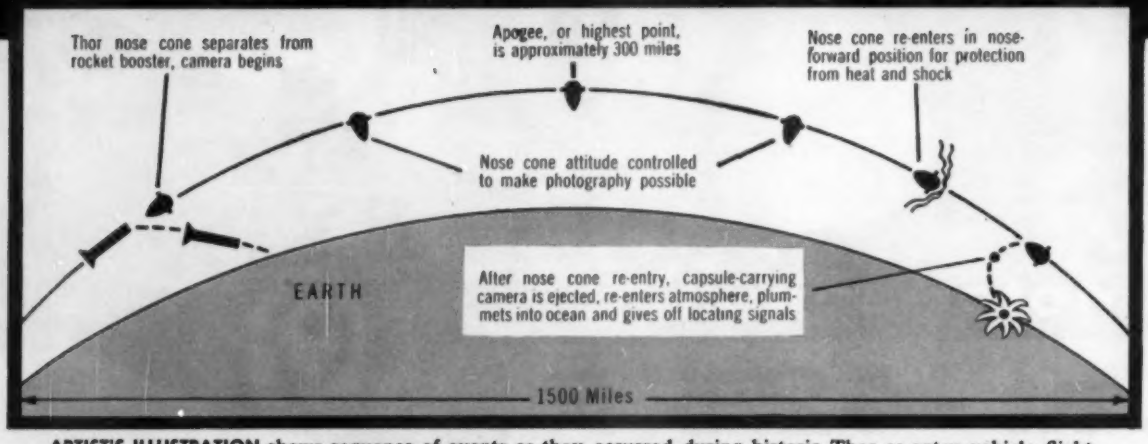
Copyright 1959 - Hydromatics, Inc.

THROUGH GENERAL ELECTRIC PROGRESS IN SPACE TECHNOLOGY . . .

USAF Gets Dramatic

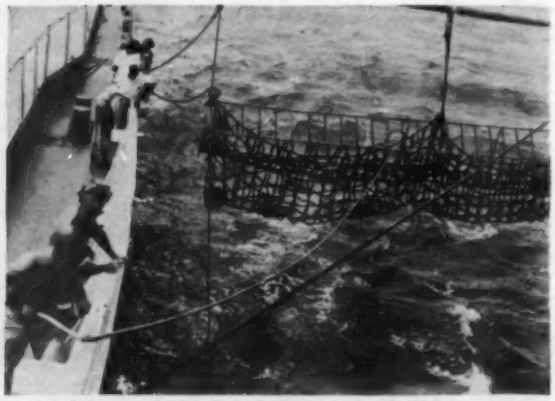
Thor missile separates from re-entry vehicle and camera shows inside front portion of the missile which had housed the re-entry vehicle

Camera continues to photograph separation portion of flight; shows Thor missile still in foreground with Earth just visible


Thor nose cone separates from rocket booster, camera begins
Apogee, or highest point, is approximately 300 miles
Nose cone re-enters in nose-forward position for protection from heat and shock
Nose cone attitude controlled to make photography possible
EARTH
After nose cone re-entry, capsule-carrying camera is ejected, re-enters atmosphere, plummets into ocean and gives off locating signals
1500 Miles

ARTIST'S ILLUSTRATION shows sequence of events as they occurred during historic Thor re-entry vehicle flight

"SPACE CAMERA" is inserted in MSVD-developed recoverable capsule which was placed in Thor re-entry vehicle



USAF RECOVERED CAPSULE from Atlantic 1400 miles from Cape Canaveral only 39 minutes after missile launching

Film from Outer Space

Distance between re-entry vehicle and missile grows; cloud formations are visible above Atlantic Ocean and Florida

At the vicinity of 250 miles in space, camera shows wide Earth and sky panorama and now distant falling Thor missile is just visible

General Electric Missile and Space Vehicle Department Equipment on USAF Thor Missile Makes Possible Pictures of Earth Never Before Achieved, Successful Camera Recovery from Ocean

Now, for the first time:

- a motion picture has been made of Earth from outer space at distances from 90 to 300 miles and has been successfully returned through the Earth's atmosphere
- scientists can view a film sequence that shows a missile in actual space flight performing functions never actually seen before

To obtain this historic motion picture, a USAF Thor missile launched from Cape Canaveral on May 12 carried a General Electric-developed re-entry vehicle housing a recoverable capsule which contained a 16-millimeter camera. As the Thor booster and re-entry vehicle separated, approximately 90 miles up over the Atlantic Ocean, the camera was triggered into operation and began for the first time an actual film recording of a missile separation in space. As the camera-carrying re-entry vehicle sped on its way into space, the booster fell further and further away revealing an expanding panorama of Earth.

General Electric's Missile and Space Vehicle Department in Philadelphia developed and built both the re-entry vehicle and the recoverable capsule used in this flight. In addition, G-E engineers overcame complex space engineering problems to make possible re-entry vehicle stabilization and control required for space photography.

After separation, the re-entry vehicle was repositioned in flight so that the rear of the vehicle was directed toward Earth and the descending booster section. Just prior to re-entry, however, the re-entry vehicle's blunt heat shield was turned toward Earth to cope with the terrific heat and shock of re-entering through the atmosphere.

As the Thor re-entry vehicle neared the end of its 1500-mile flight over the Atlantic, the recoverable capsule containing the camera and film was ejected, plummeting into the sea. The capsule was designed by G-E MSVD engineers to withstand the tremendous pressure occurring during this impact. Floating to the surface, the capsule began sending recovery radio signals. Dye markers and flashing lights were also activated to aid in recovery.

Proved in three prior consecutive successful ocean recoveries, the MSVD capsule functioned completely as programmed. It was recovered by an Air Force ocean range vessel near the Island of Antigua . . . only 39 minutes from the time of initial missile launch.

Through its development of more sophisticated space vehicle control techniques, through its contribution in solving the ballistic missile re-entry problem and through its continuing space technology research and development program, General Electric's Missile and Space Vehicle Department continues to be the leader in space technology progress. *Missile and Space Vehicle Department, Philadelphia, Pa., of the Defense Electronics Division.*

224-56A

GENERAL ELECTRIC

MRC RELIABILITY

As the navigator relies on the North Star — so aircraft and missile guidance systems depend on reliability of components.

MRC Super-Precision Instrument Bearings offer the highest degree of accuracy and performance.

MRC

BALL AND ROLLER *bearings*

MARLIN-ROCKWELL CORPORATION Jamestown, New York

THE BOEING IM-99 BOMARC . . . *is a long range, extremely high altitude supersonic missile designed to intercept and destroy enemy aircraft and missiles. In full production, it has a greater range than any other air defense missile.*

HI-TORQUE BOLT

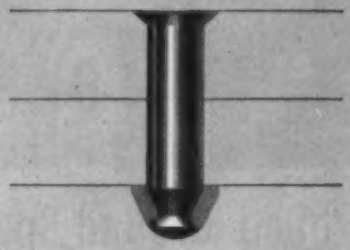
IDEAL FOR FASTENING STRESSED ACCESS AND CLOSE-OUT PANELS. ITS UNIQUE SHALLOW RECESS LOCKS THE DRIVER INTO IT WHEN A HIGH TORQUE LOAD IS APPLIED DURING INSTALLATION OR REMOVAL.

STRUCTURAL EFFICIENCY CONTRIBUTES TO GREATER PERFORMANCE

The airframe of the Bomarc reflects a successful solution to structural and fastening design problems typical to high performance missiles and aircraft. The airframe combines high strength with high temperature resistance, without adding unnecessary weight which could effect performance.

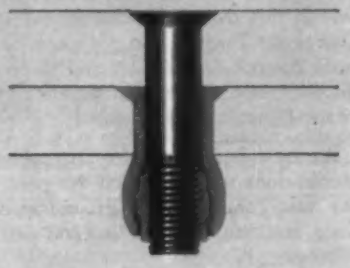
Three different fastener problems in the Bomarc are solved by stainless steel Hi-Shear fasteners. Hi-Shear Rivets are used in structure subjected to engine and rocket boost heat . . . Hi-Torque Bolts fasten removable panels and the nose section where heat, surface smoothness and ease of removal are factors. Blind Nuts eliminate hole/nut coordination problems in congested areas.

Continuing fastener environmental studies are being conducted at the Hi-Shear Test and Research Laboratories in a variety of strength and temperature resistant material combinations for advanced structural requirements.



HI-SHEAR RIVET

HAS THE LIGHTEST STRENGTH-WEIGHT RATIO, LEAST PROTRUSION AND LOWEST COST OF ANY SWAGED TYPE FASTENER. INSTALLED WITH STANDARD RIVET GUNS OR SQUEEZERS FITTED WITH HI-SHEAR RIVETING SETS.



BLIND NUT

FOR BLIND OR OPEN APPLICATIONS, THE BLIND NUT CUTS PRODUCTION COSTS BY USING ONE HOLE INSTEAD OF THE NORMAL THREE REQUIRED FOR NUTPLATES. INSTALLATION SPEED IS ABOUT TEN PER MINUTE BY ONE MAN USING A LIGHTWEIGHT, HYDRAULICALLY OPERATED GUN.

U.S. PATENT PENDING. FOREIGN PATENTS GRANTED AND PENDING.

"HI-TORQUE" TRADEMARK REGISTERED IN U.S. PATENT OFFICE. U.S. PATENTS NO. 2,677,885; 2,925,120 AND 2,951,000. U.S. PATENT PENDING.

"HI-SHEAR" TRADEMARK REGISTERED IN U.S. PATENT OFFICE. U.S. PATENTS NO. 2,300,579; 2,369,900; 2-120-079; OTHER U.S. AND FOREIGN PATENTS PENDING.

hi-shear RIVET TOOL COMPANY

2600 WEST 247TH STREET, TORRANCE • CALIFORNIA

Philco Ground-Space Communications System commands and tracks **DISCOVERER** satellite

DISCOVERER . . . the United States' newest earth satellite . . . is opening new vistas on the frontier of outer space. And Philco is proud to play an important role in this renowned achievement as a part of the Discoverer Team . . . in conjunction with the Lockheed Aircraft Corporation and the Air Force at the direction of the Advanced Research Projects Agency of the Department of Defense.

As the subcontractor for Discoverer's entire communications system, Philco designed and developed the vast complexity of ground-space communications, tracking, commanding and data gathering and processing systems.

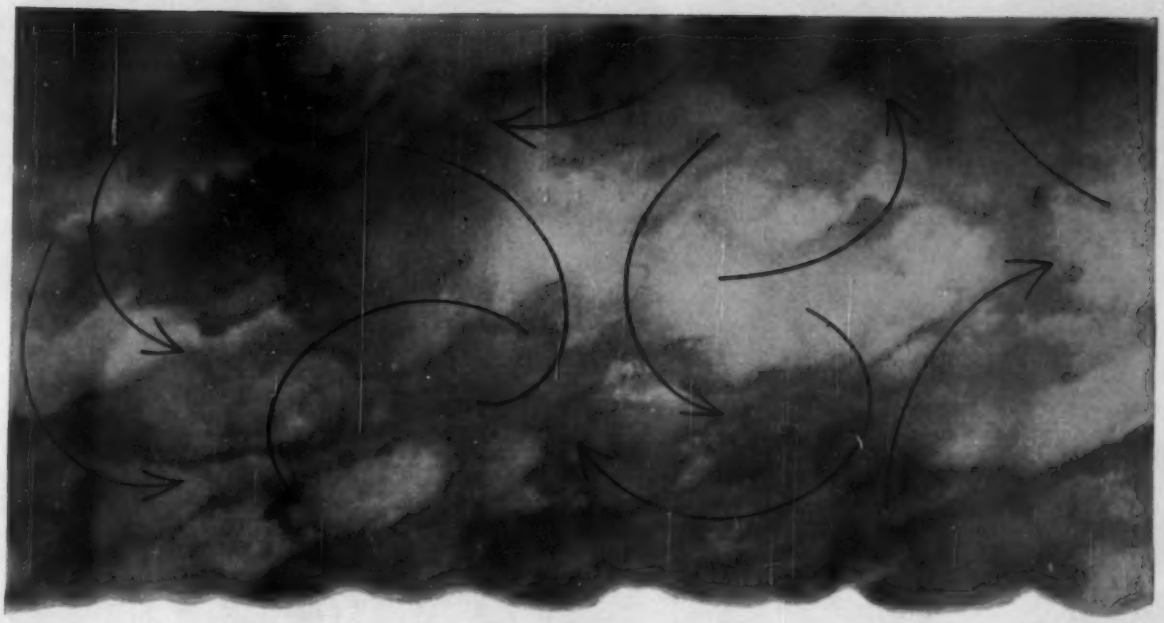
The Philco-designed and equipped system observes and commands Discoverer through a series of five tracking and data collection stations in Alaska, California, Hawaii and a specially equipped ship at sea. Philco continues its participation in the Discoverer Program by assisting in the actual operation and maintenance of the communications and data handling network.

Philco's part in the Discoverer Program is typical of the many and diverse advanced research and development activities being conducted in our laboratories on the East and West Coasts where outstanding career opportunities abound for Engineers, Mathematicians, and Physicists.

In the wonder-world of advanced electronics, look to the leader. Look ahead . . . and you'll choose Philco!

PHILCO®

GOVERNMENT AND INDUSTRIAL DIVISION
WESTERN DEVELOPMENT LABORATORIES
PHILADELPHIA, PENNSYLVANIA PALO ALTO, CALIFORNIA



all-weather radar finds *the calm corridor*

Providing a clear picture of turbulence cells in storms ahead, Hughes TONOTRON* tube gives your airborne weather radar exceptional ability to find the "calm corridor."

Hughes TONOTRON tube gives you several features which make it ideal for weather radar readout and ground mapping:

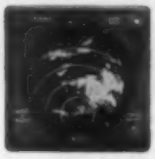
Full Gray Scale—Seven different shades of gray.

High Picture Brightness—In excess of 1500-foot lamberts with full halftone range. Even in full sunlight no viewing hood is required—thereby providing maximum safety.

Controllable Persistence—Gives you flexibility in analyzing the complete weather problem.

Developed by the famed Hughes Research and Development Laboratories, the TONOTRON tube is just one of the nation's largest family of storage tubes!

For further information about the TONOTRON tube, please write: Hughes Products, Electron Tube Sales, International Airport Station, Los Angeles 54, California.



The new Bendix Airborne Weather Radar uses the Hughes TONOTRON tube for a high-fidelity picture reproduction. With this system the pilot can keep an area as great as 150 miles ahead and to the right and left, under constant observation—day or night.

The Hughes TONOTRON tube

Applications: Airborne weather radar, "B" scan radar, armament control radar, plan position indicator information and slow-scan television.

Available models: Electrostatic deflection, 3-inch, 4-inch and 5-inch diameters. Magnetic deflection, 5-inch and 21-inch diameters.

*TRADE-MARK OF H. A. C.

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

© 1959, HUGHES AIRCRAFT COMPANY

SEMICONDUCTOR DEVICES • STORAGE AND MICROWAVE TUBES • CRYSTAL FILTERS • OSCILLOSCOPES • RELAYS • SWITCHES • INDUSTRIAL CONTROL SYSTEMS

The Pentadome structure, developed by an industrial team in cooperation with the U. S. Army Quartermaster Corps, was designed to meet Ordnance Corps requirements for a missile maintenance shelter.

NEW BIRDAIR STRUCTURE to guard our nation's defenses

COOPERATING MANUFACTURERS

Nylon Base Fabric by

WELLINGTON SEARS CO.

111 WEST 40th STREET • NEW YORK 18, NEW YORK

Special fabric construction for the Pentadome was supplied by Wellington Sears, manufacturers of famous "Welkote" nylon fabric specially engineered for vinyl and neoprene coating.

Coated Fabric by

THE H. M. SAWYER DIVISION

SAWYER-TOWER, INC.

WATERTOWN 72, MASSACHUSETTS

Special vinyl coating compounds and their application to meet rigid military specifications were provided by Sawyer for the Pentadome. Sawyer's "Tuff-Tarp" is world renowned for its excellent properties and high quality.

Inflation Equipment by

THE PEERLESS ELECTRIC CO.

1401 W. MARKET STREET • WARREN, OHIO

The "heart" of the Pentadome, its inflation and its pressurization blowers, were provided by Peerless, builders of a complete line of high quality air moving equipment ... fans, blowers, and electric motors.

This is Pentadome, the largest air-supported structure ever built for military use. It is made up of five — one large, and four small — domes which can be used either in combination, or individually.

The main dome is 150 feet in diameter and 85 feet high; the smaller domes, 100 feet in diameter and 50 feet high. A total ground area of 50,000 sq. ft. and volume of over 2,000,000 cu. ft. are protected.

With vinyl-coated nylon fabric as the basic construction material, shape and stability are attained (and maintained) through constant low-pressure, high-volume, air supplied by electric powered blowers.

Thus, *no* rigid supports, poles or frames are needed. There are no obstructions to hinder the free movement of missiles or other large pieces of equipment.

The Pentadome is held in place by anchors driven into the ground around its perimeter. It is designed to withstand a constant wind load of 70 miles per hour and gust loads of greater velocity.

Ten men, during a single working day, can erect the Pentadome, after proper anchorage installations have been made. A deflated Pentadome can be transported on standard military vehicles.

Although developed as missile inspection and maintenance shelter, the Pentadome configuration appears to have many other military and commercial applications. For example, experts have suggested its use as a storage enclosure, as a protection for construction activities, and as an exhibit enclosure.

If you have a problem that might be solved with this new approach to space enclosure, we will be glad to send complete specifications, or to arrange a conference at your convenience. Address inquiries to:

BIRDAIR STRUCTURES, INC.

Dept. AW-1, 290 Larkin St., Buffalo 10, N. Y.

Originators of Modern Air Supported Structures

RE-ENTRY SHIELDS

EST 1883

WYMAN-GORDON IS FORGING RE-ENTRY SHIELDS

- Copper in production
- Beryllium in limited production
- Reinforced plastics in development

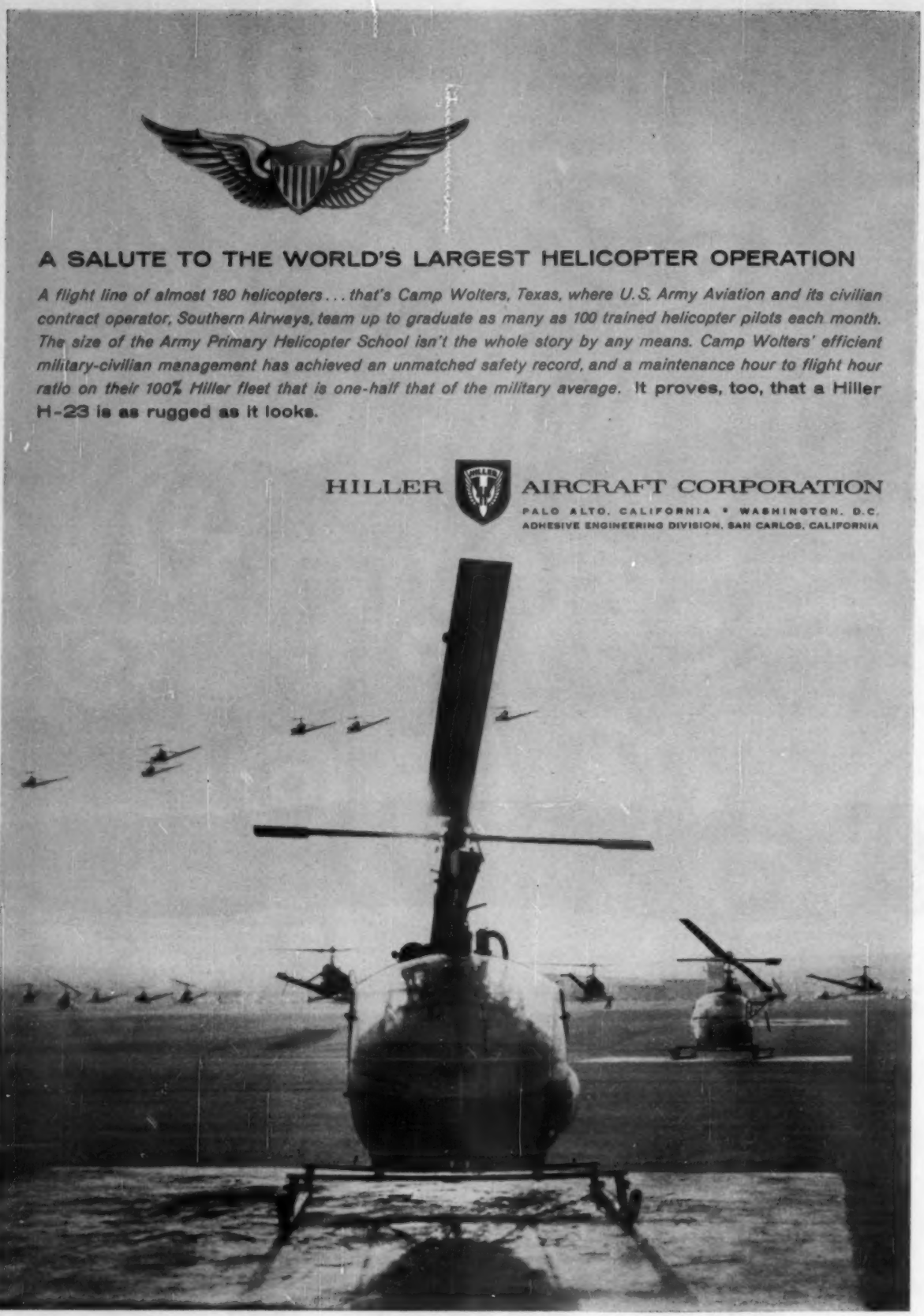
WYMAN-GORDON

FORGING

ALUMINUM MAGNESIUM STEEL TITANIUM BERYLLIUM MOLYBDENUM COLUMBIUM
AND OTHER UNCOMMON MATERIALS

WORCESTER, MASSACHUSETTS

HARVEY, ILLINOIS
DETROIT, MICHIGAN
GRAFTON, MASSACHUSETTS
FORT WORTH, TEXAS
FRANKLIN PARK, ILLINOIS
LOS ANGELES, CALIFORNIA



A SALUTE TO THE WORLD'S LARGEST HELICOPTER OPERATION

A flight line of almost 180 helicopters . . . that's Camp Wolters, Texas, where U.S. Army Aviation and its civilian contract operator, Southern Airways, team up to graduate as many as 100 trained helicopter pilots each month. The size of the Army Primary Helicopter School isn't the whole story by any means. Camp Wolters' efficient military-civilian management has achieved an unmatched safety record, and a maintenance hour to flight hour ratio on their 100% Hiller fleet that is one-half that of the military average. **It proves, too, that a Hiller H-23 is as rugged as it looks.**

HILLER AIRCRAFT CORPORATION

PALO ALTO, CALIFORNIA • WASHINGTON, D.C.
ADHESIVE ENGINEERING DIVISION, SAN CARLOS, CALIFORNIA

A candle in a dark room?

Transverse and/or Visible electromagnetic waves?

A universal constant?

How many wave lengths in a photon?

Is light affected by gravity?

A full appreciation of light and all its phenomena is essential to the successful completion of our energy conversion mission.

We use this knowledge constantly—as, for example, in our recent development of a photo-voltaic conversion system and a mechanical-optical system to convert light energy to electrical energy.

To aid us in our inquiries we call on the talents of General Motors Corporation, its Divisions and other individuals and organizations. By applying this systems engineering concept to new research projects we increase the effectiveness with which we accomplish our mission—exploring the needs of advanced propulsion and weapons systems.

Energy conversion is our business

ALLISON

Division of General Motors, Indianapolis, Indiana

PRECISION-BUILT JET PODS FOR THE DC-8

PROBLEM—package the power of 16 locomotives and enclose it in a slim, streamlined pod.

SOLUTION—1) assign 100 power plant, aerodynamic, and aircraft structures engineers to work closely with Douglas design specialists, 2) put master-craftsmen through postgraduate training programs, 3) design and build the finest precision jigs and tools, 4) meet the most exacting standards ever established for air-frame manufacture.

RESULT—gleaming pods that enclose ready-to-go jet power for Douglas' superb DC-8 Jetliner and supporting pylons also built by Ryan. These jet pods are an important contribution to the success of another great new airliner—created in the finest Douglas transport tradition.

Ryan is well-equipped to meet the challenges of precision production of DC-8 pods and pylons. For more than 33 years Ryan has produced air-frame and engine structures for Douglas planes. Ryan is proud of this long association and the confidence which Douglas has placed in Ryan products and the excellence of their performance.

RYAN BUILDS BETTER

AIRCRAFT · POWER PLANTS · ELECTRONICS

Ryan Aeronautical Company, San Diego, Calif.

June 8, 1959

Aviation Week

Including Space Technology

Vol. 70, No. 23
Member ABP and ABC

EDITORIAL OFFICES: New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Nights LO 4-3035) Washington 4, D. C.—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630 Los Angeles 17—1125 West Sixth St., Phone: HUntley 2-5450 Dallas 1—1712 Commerce St. Phone: Riverside 7-5117 European Office—1 rue du Temple, Geneva, Switzerland, Phone: 32-35-63

PUBLISHER .....Robert W. Martin, Jr.
EDITOR.....Robert B. Hotz

MANAGING EDITOR.....William Gregory
EUROPEAN EDITOR.....David A. Anderton
WASHINGTON.....Cecil Brownlow
NEW YORK..Robert I. Stanfield, Harry Raven, Herbert J. Coleman
LOS ANGELES..Irving Stone, Richard Sweeney, Russell Hawkes, William S. Reed
DALLAS.....Craig Lewis
ENGINEERING..J. S. Butz, Jr., Michael Yaffee
AVIONICS...Philip J. Klass, James A. Fusca
CONGRESS..Katherine Johnsen, Ford Eastman
SPACE TECHNOLOGY.....Evert Clark
TRANSPORT.....Glenn Garrison, L. L. Doty, Robert H. Cook
EQUIPMENT.....Barry Tully
BUSINESS FLYING.....Erwin J. Bulban
ART EDITOR.....Lawrence J. Herb
SPECIAL PROJECTS .....John A. Nammack
EDITORIAL PRODUCTION....Arnold Sherman
ASSISTANT EDITORS....Elizabeth M. Hein, Edith Walford
EDITORIAL ASSISTANTS.....Marjorie Nail, Jerome Bailey, Marjorie Todd

FOREIGN NEWS SERVICE

EDITOR.....John Wilhelm
LONDON.....John Tunstall
PARIS.....Robert E. Farrell
BONN.....Morrie Helitzer
MEXICO CITY.....Peter Weaver
TOKYO.....Sol Sanders

DOMESTIC NEWS BUREAUS

ATLANTA 3.....1301 Rhodes-Haverty Bldg.
CHICAGO 11.....520 No. Michigan Ave.
CLEVELAND 15.....1510 Hanna Bldg.
DETROIT 26.....856 Penobscot Bldg.
HOUSTON 25.....1303 Prudential Bldg.
SAN FRANCISCO 4.....68 Post St.

SALES

ADVERTISING SALES MANAGER E. P. Blanchard, Jr.
ATLANTA.....R. H. Powell
BOSTON.....A. C. Boughton
CHICAGO and ST. LOUIS .....J. S. Costello, D. C. Jackman
CLEVELAND.....H. P. Johnson
DALLAS.....R. T. Wood
DENVER.....John G. Patten
DETROIT.....R. R. Butera
LOS ANGELES.....C. F. McReynolds, D. T. Brennan, C. A. Ransdell
NEW YORK.....M. J. Storz, J. M. Grinton, J. D. Warth
PHILADELPHIA..J. D. Willis, W. L. Blanchard
SAN FRANCISCO.....William Woolston
PROMOTION & RESEARCH MGR..C. C. Gersna
RESEARCH & MARKETING Mary Whitney Fenton, Jacqueline Gonnet

BUSINESS

BUSINESS MANAGER.....J. G. Johnson
CIRCULATION MANAGER.....T. J. Lucey
ASST. BUSINESS MANAGER ..W. V. Cockren
PRODUCTION MANAGER.....F. A. Dube

Congress Raps Industry Contract Costs..... 26
▶ House group cuts funds, tells services to tighten management; Rep. Vinson scores 'overpricing.'

Locals' Equity Financing Looms as Issue..... 36
▶ Guaranteed Loan program is involved in CAB's demand that local carriers broaden ownership.

Centrifuge Checks Orbital Pilot Stresses..... 52
▶ Tests indicate that acceleration forces during launch and re-entry will permit optimum performance.

SPACE TECHNOLOGY

Centrifuge Checks Orbital Stress.... 52
Jupiter Launch Tests Primates..... 30
Mice Launched in Discoverer III..... 33
Radar Tracking Range Boost Studied. 35
USAF Develops Space Primates' Seat. 55
Battelle to Study Space Oxygen System 59

AERONAUTICAL ENGINEERING

T64 Designed in Three Versions.... 61
Northrop Rolls Out First N-156F..... 29
Doak VTOL Demonstrates Conversion 34
Centrifuge Furthers X-15 Pilot Safety 69
Gulfstream Production Hits Stride... 84

EQUIPMENT

Internal Combustion Catapult Tested. 89
New Aviation Products..... 91

FINANCIAL

Martin Expands to Win Business.... 97
Small Business Competition Tightens. 105
AMC Contracts 103

AIR TRANSPORT

Locals' Equity Financing at Issue.... 36
Ayer Credit Deal..... 37
United to Begin DC-8 Flights..... 38
Dim Future for Surplus Planes..... 39
Minetti's Dissents Follow Pattern.... 41
Vanguard Tours Europe in Sales Drive 44
Trans Caribbean Fare Approved..... 45
Cargo, Local Lines Report Salaries ... 50
Shortlines 47
Airline Observer 47

MANAGEMENT

Congress Raps Industry Contract Costs 26
House Approves Defense Funds..... 28
Who's Where 23
Industry Observer 23
Washington Roundup 25
News Digest 35

Calendar 5
Letters 122

EDITORIAL

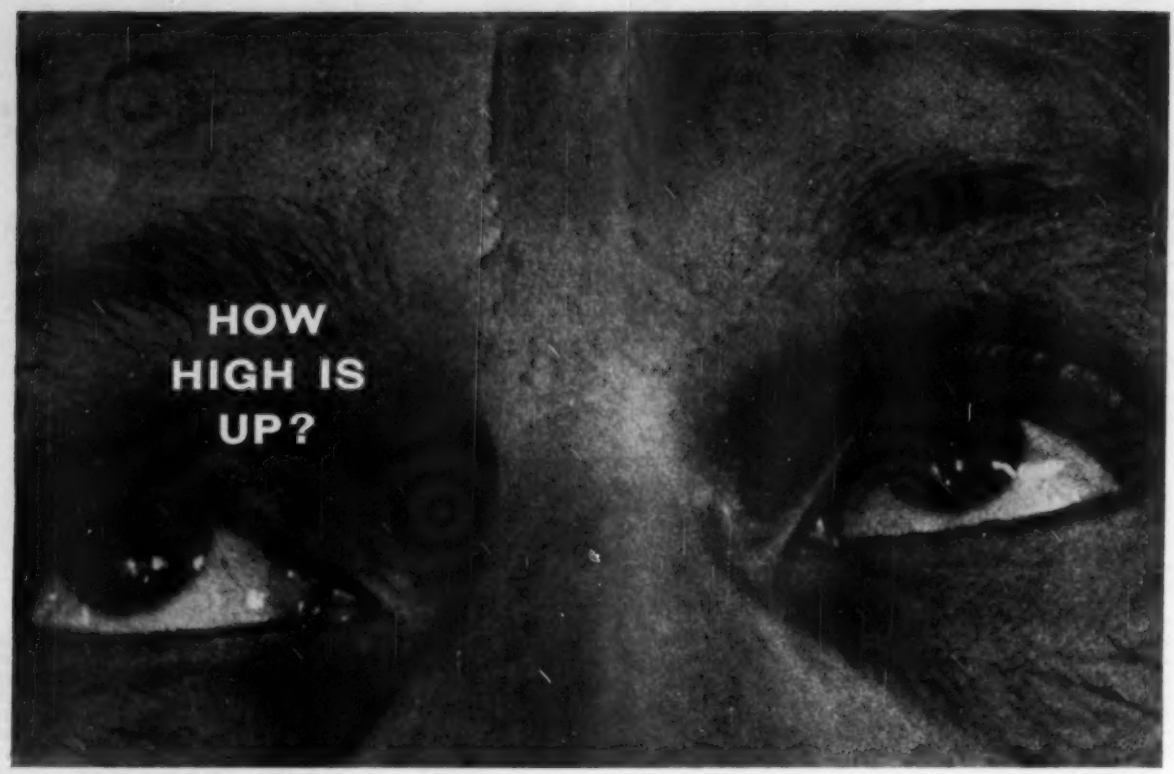
Jet Era Problems..... 21

COVER: Doak VZ-4DA VTOL aircraft (Doak Model 16) is midway in conversion from forward flight to hovering configuration at a pressure altitude of 3,000 ft. over Edwards AFB, Calif. Company's chief test pilot, James B. Reichert, is at the controls. The aircraft, built for the Army as a research vehicle for the tilting ducted for VTOL concept, has made successful vertical takeoffs, conversions to forward flight, and return. For complete transition sequence, see p. 34.

PICTURE CREDITS

Cover—Doak; 29, 53, 69—Northrop Corp.; 31—U. S. Army; 33, 55—USAF; 34—Doak; 43—Boeing Airplane Co.; 44, 45—Vickers-Armstrongs, Ltd.; 50—Airborne Instruments Laboratory; 52—David Cobb, Carl Lafors; 61, 64—General Electric; 75—Vertol; 77—English Electric Co., Ltd.; 84, 85—Grumman Aircraft Engineering Corp.; 86, 87—Kaman Aircraft Corp.; 89—Thiokol Chemical Corp.

77,157 copies of this issue printed



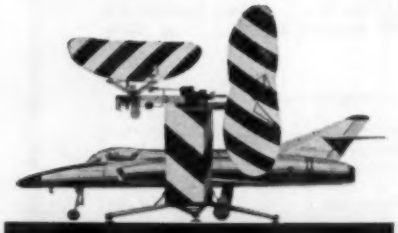
Quadradar provides rapid accurate altitude of all aircraft in terminal area!

Provides greater safety through rapid coverage of all runways from one location

Gilfillan Quadradar provides rapid, accurate altitude, azimuth and range information on any aircraft, up to 50,000 feet. Quadradar provides further safety with rapid coverage of all runways from one location.

With Quadradar, pilots are informed of other aircraft in the terminal area, reducing collision hazards. Aircraft are landed from either direction of runways without relocating equipment.

Quadradar provides terminal area surveillance, final approach, height-finding and airfield surface information. It is compatible with present systems to make for greater safety in final approach, air traffic control and high-performance climb-outs.



Gilfillan
LOS ANGELES

SEVEN GILFILLAN PLANTS IN SOUTHERN CALIFORNIA / HEADQUARTERS: 1815 VENICE BOULEVARD, LOS ANGELES, CALIFORNIA

GILFILLAN QUADRADAR IS NOW IN OPERATION BY THE U.S. ARMY, USAF, U.S. NAVY, U.S. MARINE CORPS, ROYAL CANADIAN AF, ROYAL DANISH AF, FRENCH AF, ARGENTINE NAVY, GERMAN AF, ITALIAN AF, FINNISH AF, YUGOSLAV AF, ISRAELI AF, IRISH CAA, ROYAL AUSTRALIAN AF, FRENCH CAA, AUSTRIAN CAA, BOEING AIRPLANE CO., AND NORTHWEST AIRLINES. LOCKHEED, DOUGLAS, CONVAIR, NORTH AMERICAN AND HUGHES AIRCRAFT COMPANIES HAVE A JOINT OPERATION USING QUADRADAR AT PALMDALE FLIGHT TEST CENTER. OTHER INSTALLATIONS INCLUDE MOFFETT NAS, AND AT THE SOUTH POLE.

EDITORIAL

Jet Era Problems

(Operational problems the airlines and their pilots can expect to face as they move deeper into the jet era—and how they must be overcome—were recently outlined by Maj. Gen. Joseph D. Caldara, Air Force director of flight safety research, based upon the broad base of knowledge and experience USAF has gained thus far. Because of its significance to the airlines, and to the aviation industry as a whole, AVIATION WEEK *is reprinting below major extracts of the speech made at a Washington meeting of the Aviation Writers Assn.)*

. . . Likely problem areas by phase of flight for civil flight, as based on Air Force experience during 1958, can be presented.

This brings me to the jingle . . . "it's what's up front that counts." Accident inducing factors are more critical in jet aircraft as pilots enter this area of flight. In the Air Force, the first 200 hr. of jet time comprise the most dangerous area for transitioning pilots. Our records show that 60% of our jet bomber accidents involve pilots with less than 200 hr. of jet experience. One notable conclusion from studies on the subject is that thousands of hours of conventional flying time do not necessarily enhance the qualifications of a pilot assigned to fly a jet.

Preflight planning or briefing is a big item in jet operations. In addition to the old-fashioned items, some additional weather phenomena are covered. These include height of the tropopause, temperature departure from standard, high altitude turbulence and jet streams. Surface weather conditions—ceiling, visibility, temperature, pressure and winds—are most thoroughly covered. There is no time to waste at the end of the ride—because there is no fuel.

As it has always been in the past, the takeoff represents a very critical portion of the flight. The use of acceleration checkpoints during take off roll, maximum refusal speeds and distance as well as unstick or lift off speed is of extreme importance. Billboard type markers at 1,000 ft. intervals along the runway are absolutely inadequate, although they are the only means to assist the pilot at this time. Some sort of takeoff monitor is a must if we wish to avoid a catastrophic abort. The best proof of this is the fact that B-47 aborted takeoff accidents are consistently 100% fatal. . . .

One serious problem in the phase is anticipating when traffic clearance will be received in sufficient time to start engines and takeoff. Engine ground operating time at idle rpm. costs a KC-135 approximately 18 gal. of fuel per minute. For your information, a KC-135 grossing 260,000 lb. at takeoff requires about 2,000 lb. of fuel to complete takeoff roll and accelerate to climb speed. . . .

Variables in temperature, terrain and pressure altitude, plus certain inherent characteristics of the jet engine, are of vital importance to accurate performance planning for jet transports. Engine operating conditions which before could be generalized, now must be specific.

The biggest headline makers in aviation today are midair collisions. Although flying is safer than ever today and we can prove it, whether we measure our safety in airline miles or in hundreds of thousands of hours successfully flown, public opinion is formed by every accident we have—particularly dramatic ones like midair collisions. . . .

Midair collisions represent only 3½% of all major accidents in the Air Force. I don't mean for one second to minimize the importance of midair collisions. I want only to impress upon you the disproportionate effect this type of accident sometimes has on the public mind in terms of the over-all safety picture.

The reason most midair collisions ever occur is because the days of "see and be seen" flying are gone, and I'm glad to say, we in the Directorate of Flight Safety Research recognized this problem long before the famous Grand Canyon and Pacoima School disasters. In fact, we first expressed the need for an anti-collision device in aircraft cockpits over five years ago, and both of these accidents could have been prevented had such a device been in existence.

Aside from traffic control, there are two factors at work to make a collision possible, and these are two factors which every jet pilot—military and commercial alike—must know and respect. First, the almost fantastic rate of head-on closing speed in high performance aircraft and, second, the built-in limitations of man whose reactions are appallingly slow when pitted against the rapidity of events that can occur during high speed flight. . . .

. . . One of the most important decisions the jet pilots make is when to let down. Fuel consumption by a jet engine increases astronomically as altitude decreases. Premature descents to low altitude or holding at low altitude imposes a severe penalty. After a long over-water or transcontinental flight, jet aircraft cannot descend to make a couple of passes at a field and then climb back to altitude and proceed to an alternate. The pilot must have timely and accurate present and forecast terminal weather conditions prior to his arrival at his destination, early enough so that he can safely continue or divert as the case may be. . . .

A recent study showed the Air Force experienced 235 major undershoot accidents which were not preceded by any emergency. Of this nature, 195 involved jets. All except four of the 235 undershoots occurred under contact conditions, and all except 15 occurred with visibility greater than three miles. . . .

The primary reason for a short landing is poor airspeed control on final approach, excessive rate of descent or late flareout for landing. The real trick here being the difference between jet thrust and propeller horsepower. Part of the problem here is the time it takes to accelerate a jet engine from idle to high rpm. and the fact that most of our thrust increase takes place in the last few per cent of rpm. One modern engine gets a 40% increase in thrust in the last 7% of engine rpm. increase. . . .

It is my firm belief that equipment now under tests can contribute materially to the safety of military and civilian jet operations. I strongly urge that we avoid a continuation of paralysis through analysis. Get this new equipment and in so doing guarantee to every passenger on civil airlines that the best and only the best is what's up front!!!

new

THOMAS A.

EDISON

oil pressure indicating system withstands vibration to 2000 cps at 20g's

Transmitter is mounted directly on engine and connected to panel indicator and power source by 3 unshielded copper wires.

Indicator is hermetically sealed — requires less than 0.6 watts to operate. When power is off pointer will move off-scale below zero. Available in 1½" and 2" (shown above) sizes. Two-inch size may be integrally lighted.

Designed for use on all new jet engines, the new Edison oil pressure indicating system consists of two components — a transmitter and panel indicator. Because the Model 318 transmitter can withstand vibration to 2000 cps, it may be mounted directly on these engines without shock mountings. As a result, it offers greater reliability, accuracy and speed of response.

Ordinary transmitters must be mounted off the engine and then connected by hose or tubing to engine pressure source. In sub-zero temperatures oil in hose can thicken and false or delayed pressure indications may result.

The new Model 318 transmitter is 50% smaller and 50% lighter (1.0 lb.) than the model 218 developed by Edison in 1956. It will meet requirements of new specification MIL-T-26638.

Its simplified electro-mechanical design makes installation and maintenance easy. Frictionless transmitter has only one moving part and maintains its accuracy in temperatures to 232 C.

For additional information write for publication 3049.

Thomas A. Edison Industries

INSTRUMENT DIVISION

49 LAKESIDE AVENUE, WEST ORANGE, N. J.

EDISON ENGINEERING OFFICES ARE LOCATED IN: CHICAGO; DALLAS; DAYTON; LOS ANGELES

WHO'S WHERE

In the Front Office

Harold E. Gray and **Wilbur L. Morrison**, directors, Pan American World Airways, Inc. Mr. Gray is executive vice president of the company's Atlantic Division; Mr. Morrison is executive vice president of the Latin American Division.

Robert E. Achenbach, a director, Flight Support, Inc., Metuchen, N. J. Mr. Achenbach is vice president-engineering and production.

Harold S. Geneen succeeds **Edmond H. Leavey**, retiring, as president and chief executive officer of International Telephone and Telegraph Corp., New York City, N. Y.

William A. Roth, executive vice president, Space Corp., Dallas, Tex.

George A. Spater, an executive vice president, American Airlines, Inc. Mr. Spater will serve as the airline's general counsel.

Newton V. Turney, a vice president, United Research Corp., Menlo Park, Calif., a subsidiary of United Aircraft Corp.

George T. Scharffenberger, a vice president, Litton Industries, Inc., Beverly Hills, Calif., and president of Westrex Corp., Port Washington, N. Y., a Litton division.

John A. Collings, assistant to the president, United Aircraft Corp., East Hartford, Conn.

The Federal Aviation Agency, Washington, D. C., has established a Collision Prevention Advisory Group and made the following appointments: **Robert M. Buck**, chairman, and **Philip J. La Rochelle**, recorder. Military and civil members are: **W. Cary Robinson**, Department of the Army; **James M. Brearley**, Department of the Navy; **Capt. Charles T. Howard**, Department of the Air Force; **Victor J. Kayne**, Aircraft Owners and Pilots Assn.; **Frank C. White**, Air Transport Assn.; **William K. Lawton**, National Business Aircraft Assn.

Honors and Elections

Brig. Gen. Harold R. Harris (USAF, ret.) has been elected chairman of the board of governors and executive committee of Flight Safety Foundation, Inc., New York, N. Y. **Harper Woodward** has been elected chairman of the Foundation's committee on finance and development. Newly elected directors of the Foundation are: **Air Vice Marshal Sir Victor Tait** (RAF, ret.); **S. Paul Johnston**, director of the Institute of the Aeronautical Sciences; **Richard M. Jackson**, an associates of Laurance S. Rockefeller.

The Royal Aeronautical Society of Great Britain has awarded Honorary Fellowships to: **Prof. J. Ackeret**, Professor of Aerodynamics, Eidgenossischen Technischen Hochschule; **Sir William S. Farren**, technical director, A. V. Roe & Co. Ltd.; **S. B. Gates**, chief scientific officer and consultant to the Director of the Royal Aircraft Establishment. The Society awarded Honorary Companionships to: **E. C. Bowyer**, director and chief executive of the Society of British Aircraft Constructors; **Sir William Hildred**, director-general of the International Air Transport Assn.

(*Continued on page* 111)

INDUSTRY OBSERVER

► Air Force Ballistic Missile Division will soon request industry proposals for repeater-type communications satellite intended for a 5,600-mi. polar orbit. Program, sponsored by Advanced Research Projects Agency, is expected to provide major improvement in Arctic communications for air defense and Strategic Air Command bombers (AW April 27, p. 28).

► Also watch for ARPA to award a contract for advanced work on a satellite interceptor to Radio Corp. of America's Missile Electronic & Controls Department, Burlington, Mass., within the near future. Program is a continuation of an earlier anti-satellite study funded by ARPA under USAF's Air Research & Development Command sponsorship (AW Nov. 3, 1958, p. 23).

► Nose cone for Air Force's Minuteman solid-propellant intercontinental ballistic missile will be long and slender and covered with an ablative material to combat high temperatures under present plans. This slender nose cone will reach its target at a much greater speed than the blunt shapes now employed and will be less susceptible to countermeasures.

► National Aeronautics and Space Administration is requesting funds for development of a new, low-cost sounding rocket. Fiscal 1960 sounding rocket program also includes funds for the design and development of special measuring instruments and the launching and reception of data from about 100 rockets.

► Space Track program sponsored by the Advanced Research Projects Agency under which Air Force will integrate existing space-object tracking, computation and analysis facilities, will be expanded to develop the more sophisticated Space Track capabilities that will be required in the late 1960s. Program, now identified as electronic support system 496-L, may get up to $10 million in Fiscal 1960 funds, about half of it provided by ARPA. Project office is located at the Air Force Cambridge Research Center, Mass.

► Inability of the two companies to agree as to what constituted a fair exchange of stock is reportedly the major reason for calling an end to merger discussions between Thiokol Chemical Corp. and Marquardt Aircraft Co. (AW June 1, p. 37). Thiokol, however, is continuing merger discussions with a number of other firms, including a large chemical company.

► Navy is changing to horizontally oriented copper chaff for use in its HASP high altitude sounding rocket for use in determining wind direction. Copper chaff dropped from the nose cone of a HASP can cover 10 times the area provided by the slower-falling, faster-dispersing aluminum chaff previously used, according to the Naval Ordnance Laboratory. New chaff falls at an average speed of about 3,100 fpm. as compared with 450 fpm. for the standard aluminum foil chaff.

► Soviets plan to install a long-term automatic radio-meteorological station on its Arctic ice floe station designated Severnyy Polyus-7. Station, established 23 months ago, has drifted to an area near the coast of Greenland.

► Russian helicopter designer M. L. Mil, who built the large twin-turbine Mi-6, is studying the possibility of using turbine engines in the smaller Mi-1 and Mi-4. Mil estimates that a turbine engine could cut the Mi-1's weight by 660 lb. and sharply increase its payload, enabling it to carry as many as seven persons. He adds that a turbine-powered Mi-4 could accommodate 18 passengers instead of 10 as at present.

► Air Research and Development Command estimates that over 80% of its research and development work is now performed by out-of-house contracts. Within the U. S. ARDC now has approximately 6,400 research contracts with about 1,500 major contractors.

A THREE LEVEL ruby MASER

The Maser is a microwave amplifier utilizing energy stored in a molecular or atomic system. Emission of energy is stimulated by the input signal. Masers operate at liquid helium temperatures and have low noise levels, approaching zero db.

Recently, a university research laboratory† used LINDE single crystal synthetic ruby (Al_2O_3 with Cr_2O_3 additive) in a three-level solid state Maser. The ruby crystal was placed in the Maser's tuned cavity and a magnetic field of 4200 gauss was applied. To bring electrons from a ground state into a permissible higher energy level, a pumping frequency of 24 kMc was used and the Maser amplified signals at 9.3 kMc.

LINDE supplies other crystals, including rutile, spinel, and sapphire. (Al_2O_3). Sapphire is used in infrared optical systems, windows for higher power microwave tubes, spacers and supports in vacuum tubes, radiation pipes. It has strength at elevated temperatures, melts at 2040°C., is hard, inert, nonporous, and can be sealed to metals and glasses. Sapphire is available in the shape of domes, windows to 4½ inches in diameter, rods and special configurations.

For more information, write Crystal Products Department, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

†*Maser Action in Ruby*, by G. Makhov, C. Kikuchi, J. Lambe, and R. W. Terhune. "Physical Review," Vol. 109, No. 4, p. 1399, Feb. 15, 1958.

Linde TRADE-MARK

UNION CARBIDE

"Linde" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

Washington Roundup

President Raps Industry

Charges of industry pressure on Capitol Hill in the selection of competing weapon systems have raised the ire of President Eisenhower. Asked at his press conference last week if he had "spoken out rather sharply" to several senators "about what you have termed the munitions lobby which you feel has been bringing some pressure on some of the congressmen to try to change your defense program and plan," the President replied:

"Well, I don't know who has a right to carry outside the White House any remarks I have been making, and to make those remarks public property. That is supposed to be a little bit of a private place over there, although maybe not always.

"I don't think I have used that word (munitions lobby) . . . in public. I do say this: I may have, but I am not saying I didn't, but I don't believe I have.

"I do say this: But there is obviously political and financial considerations get into this argument, rather than merely military ones, and that is produced when people have to advertise very strongly about a particular thing companies do—obviously something besides the strict military needs of this country are becoming influenced decisions."

Earlier, the President said he still favors the production and installation of both the Air Force-Boeing Bomarc area-defense interceptor missile and the Army Nike Hercules point-defense ground-to-surface missile.

He said, however, that an over-all review of the U.S. defense system Defense Secretary Neil McElroy should be completed "within 10 days certainly" and that, "if this study shows the need for some modifications, I am quite ready to assist in making them."

Development Lag?

Watch for Federal Aviation Agency to admit shortly that its important air traffic control data processing system development program at General Precision Laboratory has fallen six months behind schedule. In addition, the program is costing more than twice as much as originally planned, due in part to additional features which FAA decided to add. Cost of the overrun has stripped FAA of all Fiscal 1959 development funds. Delay in delivery of the GPL program, however, is not expected to delay tests on the Automatic Ground-Air-Ground Communication System (AGAGCS) being developed by Radio Corp. of America for FAA.

Communications Need

Communications has become an integral part of modern weapon systems and an essential element in the proper functioning of the command structure that controls and launches these systems, Gen. Curtis E. LeMay told the Armed Forces Communications and Electronics Assn. convention last week. The Air Force Vice Chief of Staff warned that "our communications are continually lagging behind the needs of our rapidly expanding operational requirements."

Gen. LeMay cited the following examples of urgently needed improvements:

- **Greater range and more channels** from tropospheric scatter systems.
- **More reliability and security** in cryptographic devices for voice, data and picture transmission.
- **Increased speed for record-type** communications. "Our teletype must operate at speeds of pages-per-minute rather than words-per-minute," LeMay said.
- **Reliable world-wide voice** communications capability.

Gen. LeMay said the communications satellite is "an encouraging possibility."

He also noted that "other new transmission media show promise," possibly a reference to the new "earth current" technique first reported by AVIATION WEEK (May 18, p. 26).

NASA Budget

National Aeronautics and Space Administration scored a much-sought victory in the Senate last week winning authorization for the entire $485,300,000 requested for NASA by the Administration and the restoration of $4,750,000 for construction of a central facility for development of high energy solid and liquid rocket propellants which had been cut by the House (AW June 1, p. 30). Earlier, NASA Administrator T. Keith Glennan had told a Senate subcommittee that the item could delay by as much as a year NASA's efforts to develop "much more high energy propellants than any that we are presently working with . . ."

Defense Appointment

John H. Rubel, director of Airborne Systems Laboratories at Hughes Aircraft Co. and a pioneer in the development of new management concepts for large weapon system developments, is moving to Washington to take over the post of assistant Defense Department director of research and engineering under Dr. Herbert F. York. Rubel, 39, joined Hughes in 1946 and will take a leave of absence to accept the Defense post.

CAB Reversal

Airline sources are wondering if the Civil Aeronautics Board has come to believe the cliche, "don't believe everything you read," even when it includes CAB documents. Bewilderment arises from a 3-2 Board vote, last week absolving a Frontier Airlines' pilot from any negligence when his Douglas DC-3 flew into a mountain peak two years ago but made a successful emergency landing after losing nine feet of the left wing. The decision also quashed an earlier objection filed by the Civil Aeronautics Administration placing the blame on the pilot.

Board members admitted the confusion may have arisen from their own accident investigation report which literally found that the pilot had flown into instrument weather and descended below a safe altitude in mountainous terrain. CAB pointed out that its backing of an examiner's decision lifting any blame from the pilot resulted from CAA's failure to prove the charges. The mere fact that the Board may have charged the cause of an accident to a pilot during an investigation, said CAB, does not mean there is sufficient evidence to punish him.

—Washington staff

Congress Raps Industry Contract Costs

House group cuts funds, tells services to tighten management; Rep. Vinson scores 'overpricing.'

By Katherine Johnsen

Washington—Powerful congressional leaders last week turned the spotlight on alleged over-pricing in defense contracts by aircraft and missile manufacturers. Heavy pressure is being brought to bear on the Defense Department to clamp down on its procurement practices, a move it conceded last week to be "urgently needed."

House Appropriations Committee already has made a 1% across-the-board cut in all military procurement funds for Fiscal 1960 and has told the services to absorb the cuts by trimming contract costs.

General Accounting Office presented a summary of 14 Air Force contracts it has investigated over the past year which show a total over-pricing of $30 million. The summary drew immediate reaction from Rep. Carl Vinson (D.-Ga.), chairman of the House Armed Services Committee, who declared that the amount of "fictitious over-pricing" which has not been uncovered by GAO's spot investigations "is frightening to contemplate."

Vinson emphasized that, since virtually all aircraft and missile contracts are negotiated, the contractors' costs are the important element. Contract costs account for about 95% of the total contract bill to the government; the profit allowance, only about 5%.

In negotiating costs, Vinson said, government negotiators are "at the mercy" of industry representatives with a long-time specialization in procurement and production. He termed the Renegotiation Board as the government's "best and only" possibility for recapturing excessive costs.

Sen. Paul Douglas (D.-Ill.), a member of Senate Finance Committee, singled out incentive-type contracts for special attention. He charged that they are "an incentive to inflate costs" at the outset so that a firm can obtain a profit on the reduction that is subsequently made. Vinson also said he saw no advantage in the incentive-type contract in holding down costs to the government.

Rep. Edward Hebert (D.-La.), chairman of the House Armed Services Investigating Subcommittee which heard GAO's testimony, commented: "We are growing very concerned with the large amount of incentive-type contracting or premium contracting, if you want to call it that, which is supposed to produce more efficient and less costly production by the magic of larger incentive payments. However, we have had some pretty sorry blotches on this image which has been built for us." Air Force is scheduled to appear before the Hebert Committee this week on the over-pricing charges.

Robert Dechert, general counsel for the Department of Defense, told the Senate Finance Committee that the over-pricing disclosed by GAO shows that "business concerns deemed to be wholly legitimate have withheld information" from government negotiators and that "we cannot rely on the integrity and fair dealing of business concerns." He said the Department is "very worried" over the situation.

GAO Report

Six of GAO's 14 cases—which account for about $17 million of the over-pricing—were reported to congressional committees only last month. These most recent cases cited by GAO which spurred congressional concern over contract pricing are:

• **McDonnell Aircraft Corp.** GAO charges that estimates used by the company in negotiating a target price of $102 million for USAF F-101A aircraft contained estimated subcontract costs which McDonnell knew were higher than it was going to pay. "McDonnell did not furnish, and the Air Force did not obtain and consider, the information on the lower subcontract prices, and, consequently, the target costs were excessive by about $5.2 million . . ." GAO has asked the Air Force to take action.

• **Boeing Airplane Co.** In negotiating target costs of $72 million on a B-52 contract with USAF, Boeing used subcontract costs which were higher than the prices Boeing already had established with its subcontractors, GAO reported. As a result, GAO said the target costs were excessive by $5 million. Again, it has asked the Air Force to take action.

• **Lockheed Aircraft Corp.** Subcontract costs for airframe components for C-130A transports, GAO said, were over-priced by $4.1 million. The agency reported that on May 13, a week after GAO submitted its findings to Congress, Lockheed agreed to a reduction of $4.1 million in the target price.

• **General Precision Laboratory.** GAO told Congress that target prices totaling $22 million on two contracts for radar systems included over-estimates of $500,000 "because of inadequate reviews by agency officials of the contractor's estimated costs."

• **Cessna Aircraft Co.** The actual costs realized by Cessna, on a Boeing subcontract for B-52 stabilizer assemblies was 37% less than the estimate cost of $4.6 million accepted by Boeing, the agency charged. GAO said the main reason for Cessna's over-calculation was that the company was new to this type of production "and was not in a position to prepare realistic cost estimates." GAO's objection was to Boeing's use of a firm-priced subcontract with Cessna. "A form of flexible pricing, providing for revision of the price after Cessna gained sufficient cost experience, should have been used." The subcontract also included $243,000 for tooling which "Boeing and Cessna should have known . . . Cessna would not require." Cessna subsequently voluntarily reduced its price to Boeing by $242,810, "but Boeing's target price was not reduced to recognize Cessna's price reduction." GAO reported that Air Force has assured that, at the time of final settlement of the Boeing prime contract, "an adjustment will be made for inequities resulting from the manner in which the target price was established."

• **Rheem Manufacturing Co.** The company, GAO said, accepted "unreasonably high fixed price purchase order prices" from a supplier of parts for North American F-100 aircraft "without obtaining cost information from supplier in support of prices quoted."

Other cases reported earlier to Congress and reviewed last week by GAO in testimony to the Hebert subcommittee involved contracts with Friden, Inc., Avco Manufacturing Corp., Menasco Manufacturing Co., Avtron Manufacturing, Inc., AC Spark Plug Division of General Motors Corp., Firestone Tire and Rubber Co., Goodyear Aircraft Corp. and Lamber Engineering Co.

It was reported during the testimony that last January, after the first few GAO reports on over-pricing had been submitted to USAF, Gen. E. W. Rawlings, then commander of the Air Materiel Command, wrote the Aerospace Industries Assn., Electronic Industries Assn. and the National Security Industrial Assn. that he was "disturbed . . . because of the serious implications which may be drawn from this situation and of the consequences which may result." At the same time, Maj. Gen. W. O. Senter, AMC director of pro-

Soviets Add Stub Wing to Mi-6

Stub wing has been added to the Russian Mi-6 twin-turbine helicopter, probably as a research tool. One avenue the Russians may be exploring is whether such a surface could alleviate the problem of retreating blade stall by unloading the rotor on that side of the disk. A hinge line at the root indicates the surface is movable. Varying the angle of attack would be necessary at takeoff, for example, when the helicopter assumes a pronounced nose-down attitude to avoid large down loads on the surface. The stub wing might also be designed to counteract a rolling moment on the retreating blade side met in some flight conditions. Earlier photos showed the Mi-6 equipped with wheel pants (AW Nov. 11, 1957, p. 30) which have been removed here. The Mi-6 has flown with payloads as high as 24,000 lb. to altitudes of 7,500 ft.

curement and production, sent 28 major Air Force contractors a letter warning that continuance of USAF's policy of relying on information given by contractors depends "on the assurance to us that contractors are furnishing current, complete, and correct cost and pricing data before and during negotiations."

In another approach to the problem of correct pricing, the Senate Finance Committee—on the suggestion of Sen. Douglas—requested the Defense Department to supply a report on all former military officers of the rank of colonel or above who are now employed by defense industries. Sen. Douglas said he wants to thoroughly review the matter of "industry representatives sitting across the negotiating table from their former military comrades and intimate personal friends." Vinson, a member of Armed Services Committee for 45 years and chairman for 24 years, branded the practice "a menace."

Vinson's broad attack was touched off by the industry's efforts to modify the renegotiation law. He charged that the industry wants to abolish the renegotiation law, knows that it won't get what it wants by direct means and is "seeking to accomplish it indirectly."

Legislation extending the law four years was passed by the House, 379 to 133, with these developments:

• **Rep. Wilbur Mills (D.-Ark.),** chairman of the House Ways and Means Committee, maintained that several amendments made to the law by the committee (AW May 18, p. 29) and later accepted by the House "will be of benefit to industry and also will contribute to the administration of the act." Aerospace Industries Assn., in testimony before Senate Finance Committee following House passage of the legislation, said the amendments "will tend to improve administration of renegotiation in the Tax Court and beyond" but that they did little to curb the arbitrary administration of the Renegotiation Board. AIA protested the long-term extension, asked that the law be extended only one year.

• **Calling for a four-year** "as is" extension, Vinson charged in a speech on the House floor and in testimony to the Finance Committee that the amendments were specifically aimed to pave the way for more profits for aircraft manufacturers. On the final showdown, however, Vinson voted for passage of the House bill which included the amendments. He did not press for a roll-call vote on his proposal for the "as is" extension.

• **Both Department of Defense** and Renegotiation Board witnesses testified that the measure as passed by the House was acceptable.

To make his point to the Senate Finance Committee that the earnings of aircraft and missile manufacturers are already high and that they need no relief from renegotiation, Vinson pointed to sums he said they earned mostly on government contracts and have been able to invest in plant and equipment expansion. He selected six firms which are appealing Renegotiation Board determinations of excessive profits totaling $68 million and which, he said, would certainly be the chief beneficiaries of the House amendments:

• **Boeing.** The firm's own capital investment increased from $34 million in 1952 to $145 million in 1958, Vinson charged.

• **Douglas.** The private investment increased from $52 million in 1953 to $123 million in 1958, he said.

• **Lockheed.** The private investment rose from $57 million in 1953 to $129 million in 1958, according to Vinson.

• **Grumman Aircraft Engineering Corp.** The private investment increased from $13 million to $25 million over the past five years, the legislator charged.

• **North American Aviation.** The private investment mounted from $29 million to $90 million between 1953 and 1958, he said.

• **Martin.** The private investment increased from $19 million in 1953 to $81 million in 1958, Vinson said.

West Germany Buys 25 Sikorsky S-58s

Stratford, Conn.—Sikorsky Aircraft Division of United Aircraft Corp. will build 25 S-58 helicopters for West Germany's Ministry of Defense. Value of the order, which includes spare parts, is $8.7 million.

First deliveries will start in July with production schedule calling for continuing delivery rate of four per month.

West German government purchased 26 S-58s two years ago and also bought some Vertol H-21 Shawnee helicopters. Vertol is pushing sales of its twin-turbine Model 107 in West Germany and other European countries.

Administration Requests Trimmed In House Defense Budget Vote

By Ford Eastman

Washington—House last week approved a $38.8 billion Fiscal 1960 defense budget after attempts to raise or lower the Defense Appropriations Subcommittee's recommendations were easily defeated.

The amount approved was nearly $400 million less than the Administration had requested and $1 billion less than Congress appropriated for defense in Fiscal 1959. However, because of the growing Soviet ballistic missile threat, a provision was included giving the President authority to incur a deficiency in Air Force funds at any time he feels it necessary to maintain an airborne alert to prevent the Strategic Air Command from destruction in the event of a surprise attack. The final House vote on the bill was 392 to 3.

Major defeated proposals offered on the floor to change the committee's recommendations included:

- **Amendment by Rep. William E.** Minshall (R.-Ohio) to eliminate $200 million which was requested for the procurement of the Air Force-Boeing Bomarc B area defense missile.
- **Amendment by Rep. John R. Foley** (D.-Md.) to increase Air Force procurement by $10 million for the purpose of buying Fairchild F-27 turboprop transports as support aircraft.
- **Amendment by Rep. Thomas B.** Curtis (R.-Mo.) to eliminate the additional $255.3 million the committee voted for Navy anti-submarine warfare.
- **Amendments by Daniel J. Flood** (D.-Pa.) to increase military personnel funds for the purpose of maintaining Army strength at 900,000.

The bill passed by the House not only reduced the over-all amount requested by the Administration but also shifted emphasis on the defense program by cutting back in many areas and increasing the funds requested in others.

Of the $38.8 billion total, the Air Force will receive $17.2 billion, about $538 million less than requested; the Navy, $11.025 billion, about $82 million less than requested, and the Army, $9.2 billion, an increase of more than $221 million.

By category, $11.6 billion was provided for military personnel, a decrease of $10.3 million from budget requests; $10.4 billion for operations and maintenance, a decrease of $99.6 million; $13 billion for procurement, a decrease of $344.9 million, and $3.8 billion for research, development, test and evaluation, an increase of $55 million.

Major changes in programs recommended by the Appropriations Committee and approved by the House include:

- **Increase of $200 million** to provide for advances in the Army Nike Zeus anti-missile missile system and Army equipment modernization.
- **Reduction of $260 million** by eliminating funds requested by Navy for a conventional-powered aircraft carrier.
- **Increase of $85 million** to start procurement of eight additional squadrons of the Air Force-Convair Atlas intercontinental ballistic missile, boosting the total number of squadrons to 17.
- **Increase of $255 million** to boost Navy's anti-submarine warfare capability.
- **Reduction of $127.5 million** by eliminating funds for the Air Force-Martin Mace tactical missile.
- **Reduction of $162.7 million** in funds requested for production of the USAF-Bomarc area-defense interceptor missile. A total of $447.3 million had been requested for production, development, test and evaluation of the Bomarc.
- **Reduction of $101.4 million** by eliminating funds requested for Air Force procurement of jet aircraft, including 10 cargo planes and 15 utility trainers and for jet navigation trainers.

Hearings on the defense bill are still under way by the Senate Appropriations Committee. The bill may reach the Senate floor late this month or in early July.

J75 License Agreement

East Hartford, Conn.—Dassault Mirage 4 turbojet bomber will be powered by Pratt & Whitney J75 engines manufactured in France under a license agreement made last week by United Aircraft Corp. and France's Snecma.

The deal confirms an Aviation Week forecast that J75s would be built in France (AW April 27, p. 27) and possibly also will be used as powerplants for a Sud Super Caravelle jet transport. The agreement has been approved by French and U.S. governments.

The agreement provides for United Aircraft to acquire about 10% of Snecma's capital stock. In turn, Snecma also will be licensed to manufacture and sell other Pratt & Whitney engines, including the JT4 civil version of the J75, which powers the Boeing 707 and Douglas DC-8 jet transports.

Because the J75 agreement provides French military forces with a jet engine in the 25,000-lb. thrust class, Snecma will conclude its study of available engines in the upper power spectrum, according to Henri Desbrueres, president and director-general. He said, however, that Snecma will continue development of the Atar 8 and 9 engines, used in Mirage development.

ARPA Details Contract Awards; 50% Slated for Satellite Systems

Washington—More than 50% of the $410,445,000 expenditures programed by Defense Department's Advanced Research Projects Agency through Fiscal 1959 will be devoted to military satellite systems scheduled for the near future.

Bulk of these satellite contracts, which amount to $239,938,000, have been placed with Lockheed Aircraft Corp. Three projects—Discoverer, Midas and Sentry—will receive a total of $213,400,000 through Fiscal 1959. Primarily, the cost will cover the development of several types of reconnaissance systems for use in high and low orbits, recovery and stabilization of satellites and other aspects of the problem of bringing reconnaissance satellites to an operational state.

Lockheed is the prime contractor on all three of these projects with the Office of the Secretary of the Air Force acting as ARPA's representative on the Discoverer and Sentry projects and the Air Research and Development Command filling this function in the Midas program.

Second largest item on the ARPA budget is $50.2 million for propulsion and launch facilities. This includes the 1.5 million lb., eight-engine-cluster booster being developed by the Army Ordnance Missile Command which will receive $24.5 million. Remainder of the funds in this category will be spent for static test stands and launch facilities and for Convair's Centaur space vehicle. Management of this vehicle and the second stage engine being developed by Pratt & Whitney Aircraft Division of United Aircraft Corp. will be transferred to the National Aeronautics and Space Administration on the first of July.

Five lunar probes, two managed by the Army Ordnance Missile Command and three by ARDC, along with some payload development work, already have

NORTHROP N-156F jet fighter, shown during rollout, will make first flight in July; J85 turbojet engines have not yet been installed. Sidewinder air-to-air missiles are mounted on the wingtips.

been transferred to NASA but will have received $33.531 million in ARPA funds by July 1.

Project Defender, which includes practically all of ARPA's ballistic missile defense work, will have received $26,841,000 through Fiscal 1959. This includes a large amount of basic work in physics as well as the development of decoy sorting radar and other equipment leading to operational systems.

Tracking and ground environment on foreign as well as U. S. soil will receive $31,141,000. Contracts for solid rocket propellant research totaling $14,423,000 have been placed with 47 firms, universities and government agencies.

Over $8 million has been allocated by ARPA to very "far-out" systems research such as anti-gravity propulsion, radiation weapons, satellite defense systems and space intercept systems. This work is split among 28 contractors and managed by ARPA through three intermediary military agencies—the Office of Naval Research, Army Ordnance Missile Command and Air Research and Development Command.

Exploratory research, such as the study of the properties of materials at low temperatures, has been contracted for by ARPA at a total of $5,489,000. This budget item includes design studies for orbiting space laboratories to test equipment and make continuous observations and measurements in space.

Northrop Rolls Out First N-156F; Flight Tests Scheduled for July

Hawthorne, Calif.—Norair Division of Northrop Corp. last week rolled out its N-156F "Freedom Fighter," designed specifically to meet needs of allied nations for a low-cost fighter weapon system (AW July 18, 1958, p. 54).

Developed in parallel with USAF's T-38 jet trainer, the N-156F utilizes much of the design data, wind tunnel testing and present T-38 flight test data. The two aircraft have a high degree of interchangeability of parts and are aerodynamically similar.

License Agreements

The N-156F was planned for manufacture abroad. Production by foreign nations would be carried out under licensing agreements (AW Feb. 2, p. 33).

As an example of foreign production, Northrop says Japanese production of 1,000 airplanes would have the cost of the aircraft at approximately $273,000 each, minus the fire control system. This figure includes tooling for production and amortization. The fire control system could add from $32,000 to about $100,000 to the cost, depending on the customer's individual desires.

Capable of zero-launch and operation from short fields, the N-156F will be powered by two General Electric J85 engines with afterburners. Alternate powerplants in the small thrust and weight class have been considered in the design, and provisions for more advanced powerplants could be made.

Over-all length of the airplane is 43 ft. 11 in., wing span is 26 ft. 5 in. with wing tip armament, and height is 13 ft. Takeoff gross weight is 12,190 lb.

Norair Division has a contract awarded through Air Force for development of the N-156F, including production of three prototype airplanes, a static test airplane, spare parts, ground support equipment and complete technical data.

First delivery to a user for suitability testing and operational indoctrination is projected for the fall of 1960. Delivery dates for squadron service would start in March, 1961.

The rollout was attended by representatives from about 40 allied nations. Maj. Gen. J. V. Crabb, chief of staff, USAF Air Defense Command, was the main speaker.

Jupiter Launch Precedes Primate Tests

By Cecil Brownlow

Washington—First ballistic launchings of primates into space directly connected with, and specifically designed for, National Aeronautics and Space Administration's Project Mercury man-in-space program will be made later this year, probably early fall, from NASA's Pilotless Aircraft Research Station, Wallops Island, Va.

Although the late-May flight of two small monkeys over a distance of 1,500 mi. in the nose cone of an Army Jupiter intermediate range ballistic missile will provide valuable preliminary data, the parameters of the launch were not designed to provide the specific answers needed before man is put into space.

These will be found, NASA hopes, in a series of short ballistic flights from Wallops Island using Little Joe solid-propellant boosters and instrumented capsules bearing small primates, possibly ranging in size up to a chimpanzee (AW June 1, p. 27).

First Little Joe flight, which will be made without a primate aboard, is scheduled for late this summer in a test of the booster and instrumentation. If successful, it will be followed by three to four follow-on shots with primates aboard.

North American Aviation's Missile Division has a $400,000 contract to provide NASA with seven Little Joe vehicles and a launcher (AW Mar. 2, p. 23). Thrust for the Little Joe rockets will be provided by improved Thiokol Sergeants, ignited in pairs. Recruit rockets will be arranged around the Sergeants to provide a high initial boost.

Canaveral Firing

The two female monkeys fired downrange from the Air Force Missile Test Center's Cape Canaveral, Fla., complex on May 28 to a maximum altitude of 300 mi. (AW June 1, p. 37) briefly withstood acceleration forces of approximately 38g—as compared with the 16-to-22g Mercury crewmen are expected to experience. According to medical officials connected with the project, both came through without major damage, although the larger of the two died four days later.

Death of the seven pound rhesus monkey, designated monkey Able, was attributed to an adverse reaction to anesthesia which was being administered prior to an operation for the removal of one of three electrodes that had been inserted in its body for the measurement of physiological reactions during the Jupiter flight.

Col. Robert L. Hullingshorst, deputy commander of the Army Medical Research and Development Command which had responsibility for Able, said after the monkey's death last week that a preliminary autopsy produced "absolutely no visible evidence of any injury being sustained that might be traceable to the space experience."

A more detailed autopsy of Able was scheduled to have been completed by late last week.

Another Army spokesman said that similar and sometimes fatal reactions have been experienced in a small number of cases in the past. At the Army Medical Research Laboratory in Ft. Knox, Ky., where Able died, the anesthesia previously had been applied in approximately 1,000 instances to about 700 monkeys without a fatality.

Able's partner on the flight—a Navy-trained squirrel monkey weighing one pound and designated Baker—was said to have been in good condition late last week at the Naval Aviation School of Medicine, Pensacola, Fla. An electrode had been removed from its body, but no anesthetic was used.

The 15-min. flight of the two monkeys in a Jupiter nose cone, which also contained two additional biomedical experiments testing radiation effects, was made on a "space available" basis during a regularly scheduled test firing of the Jupiter. The four tests were prepared by the Surgeons General of the Army and Navy carried out under NASA's sponsorship.

Possible cosmic radiation effects on the two animals apparently were negligible. Brig. Gen. Joseph H. McNinch, commander of the Army Medical Research and Development Command, said before Able's death that the primate had been placed in the whole body counter at Walter Reed Hospital in Washington and that "the potassium 40 count in this case is well within the normal range for a rhesus monkey of his age."

Capt. Ashton Graybiel, research director of the Navy Aviation School of Medicine, described the physiological changes in the two monkeys as obtained from telemetry data during the flight as "extraordinarily small."

Capsule of the larger Able monkey was instrumented to obtain and telemeter back an electrocardiogram record, muscular reaction, heart sounds, pulse velocity from large blood vessels, body temperature, respiration rate and temperature and the pressure and relative humidity in the capsule.

Measurements on the smaller Baker supplied information on respiration, body temperature, capsule pressure and heart action.

Able also had been trained to participate in a behavioral response experiment in a test to determine the effects of weightlessness on reaction times and ability.

In the test, Able was to have depressed a small hand lever in response to the flashes of a small red light inside the compartment timed to cut in once each second. During a final prelaunch check of the capsule, however, it was found that the behavioral test interfered with the other telemetry channels, and Army technicians decided to abandon the experiment.

Physiological Changes

Physiological changes recorded during the flight, as described by Capt. Graybiel, included:

- **Able's heart rate** was "affected slightly" during the initial burnout stage, going from 140 to 175 per min., and then dropped back during the period of weightlessness to its lowest level, 134 per min. During re-entry, when the acceleration forces reached their peak, the rate jumped to 222. Normal heart rate for a rhesus runs between 130 and 180, Capt. Graybiel said.
- **Baker's electrocardiogram** showed a heart rate of 326 at lift-off which "hardly varied until it hit peak g, and then it went up to 340." During the zero g period, the beat settled back to its lowest value, 290. During re-entry, it climbed to 348, "a very good indication," Graybiel said, "of small stress on the circulatory system." Normal heart rate of squirrel monkeys covers a wide range—from 240 to 400.
- **Able's respiration rate** was 20 before lift-off and went up to 30 on launch "which isn't a big increase for a monkey." The respirations fell back to 20 during the weightless period but

Meteor Threat

Moscow—Data on micrometeorites encountered by Sputnik III plus optical and radar measurements have led a Soviet scientist to predict that a space vehicle with an area of 100 square meters will encounter a meteor body with a mass of one gram on the average of only once in 14,000 hr. of flight, a mass of 0.01 gram once every 140 hr. and a mass of 0.001 gram once every 10 hr.

USSR's V. Lutskiy, lecturer at the Moscow Planetarium, cautions, however, that the frequency of encounter can go up sharply if the vehicle enters a dense meteor shower such as is encountered several times every year in the vicinity of the earth.

For Mercury

briefly reached 66 during the re-entry phase.

• **Baker's respirations** were 55 before launch, doubled on lift-off, then settled to between 75 and 56 during zero g. "It was loafing along," Graybiel said, "and then on re-entry it got up to 156" for a period of 35 to 40 sec. before impact.

• **G forces during burnout** reached a high of 15 on a "gradual rise from the lift-off" and on re-entry hit a peak of 38g for a period of less than 1 sec.

• **Environment** within the two capsules, Capt. Graybiel said, "varied almost not at all. The trace was almost level." Highest temperature recorded in either capsule during the flight was 84F.

Another biomedical experiment carried in the Jupiter nose cone dealt primarily with the effect of cosmic rays, weightlessness and temperature on the fertilization process, cell division, cellular respiration and metabolism.

In the test, sea urchin eggs and sperm were encased in three separate vials within 10-oz. aluminum cylinders in which the fertilization reaction was triggered before and during peak acceleration.

One vial contained prefertilized eggs; another, eggs that were fertilized by a triggering mechanism during acceleration; a third, unfertilized eggs that were activated before launch. In the latter, the fertilization process was halted by a fixative triggered during deceleration.

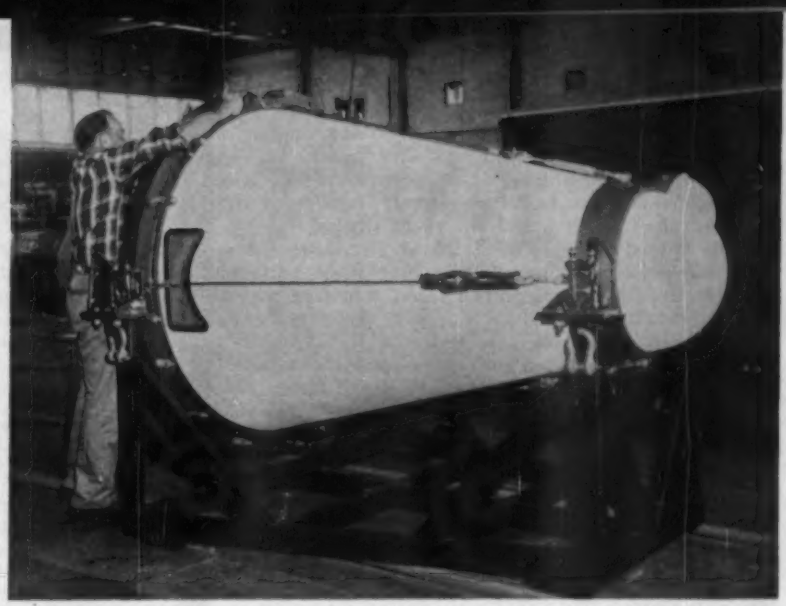
Dr. Douglas Worf, chief of NASA's biology and life-support systems, said data from these tests and later experiments using more sophisticated organisms will help determine the effect of space phenomena on the complete life cycle of a species and whether, after fertilization, the complete life cycle can be carried through. "There is," Dr. Worf said, "considerable doubt that certain species can carry through their complete cycle in this environment." He added:

"In plants, for instance, it is quite certain that the plants that have grown in a 1-g field and developed through the millions of years, would not produce normally in this condition."

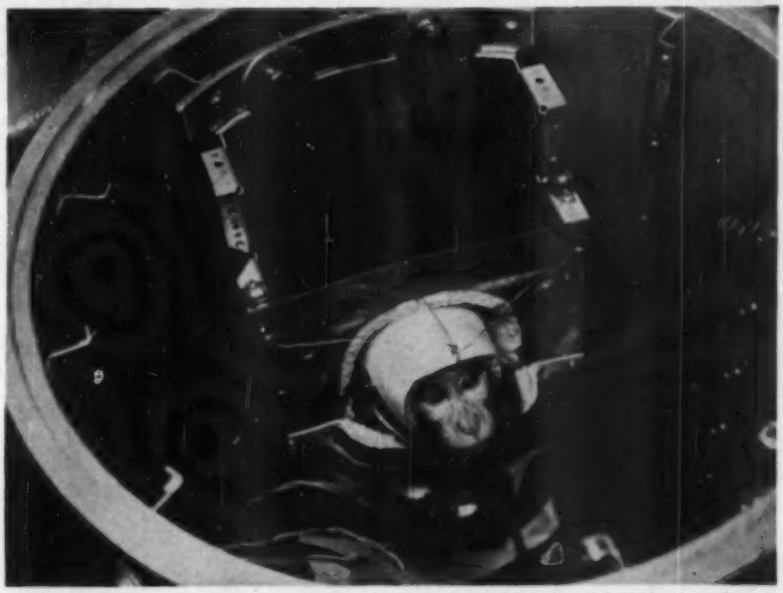
Biological Study

The nose cone also contained a biomedical pack developed by the Army Medical Research Laboratory at Ft. Knox consisting of four cylinders, each approximately one and one-half by four and one-half inches long and each containing a specific biological system. The four capsules and the purpose of the test, as outlined by Dr. James G. Kereiakes, of research laboratory were:

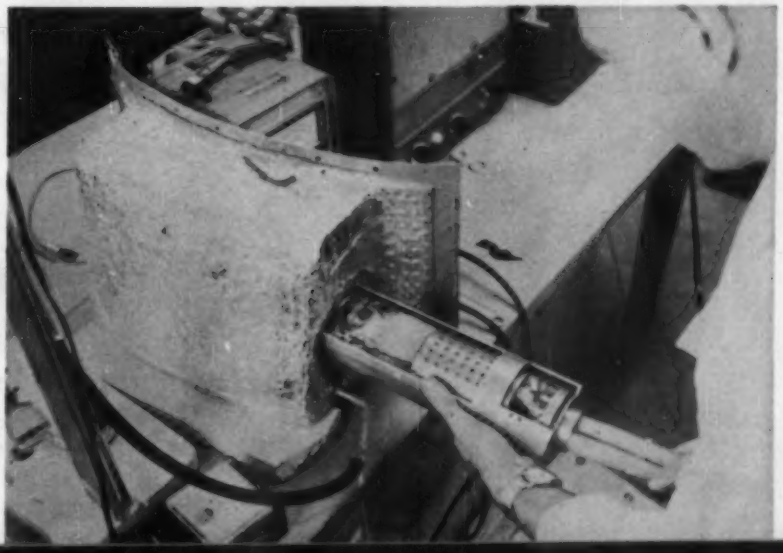
• **Cylinder containing 25 cc's** of human



JUPITER nose cone (above) carried monkey Able in semi-supine position (below), face-down during launch phase so its back would face earth in re-entry and absorb acceleration forces.



MONKEY Baker was inserted in cylinder similar to below and placed in foil-wrapped compartment that fits in Jupiter nose cone. Aluminum foil maintains constant temperature.



whole blood "to determine if the physical conditions associated with high acceleration or re-entry deceleration, the adverse physical conditions associated with missile flight, if it had any effect on the formed elements of the blood. This might be of some importance in situations of missile transport of blood for transfusion . . ."

• **Yeast cells and E. coli,** a simple form of bacteria, were housed in a second cylinder, each in a separate vial. The matter was contained within a semi-solid non-nutrient medium to keep it dormant during the time of the experiment. Later, upon its return to Ft. Knox, the suspension blocks were to have been cut and nutrient media added so that its growth could be followed at the laboratory.

• **Plant material** in the form of onion tissue and mustard seeds was carried in a third cylinder. Purpose of the experiment was to try and detect any possible cosmic ray particles on the tissue by germination or viability tests or by placing the onion tissue in a solution of triphenyl tetrazolium chloride.

• **Fourth cylinder** carried approximately 100 fruit fly pupae contained on a small piece of filter paper in a plastic vial. They will be watched to determine how many hatch into adult flies and possible malformations of the survivors. Survivors also will be bred for possible malformations or changes in their offspring.

Data is still being reduced on both the sea urchin test and the Army biomedical pack.

Because of its position in the center and high in the Jupiter nose cone, the Able capsule with the monkey inside had to be installed approximately 70 hr. before launch to permit the positioning of other components located below it.

Baker was more fortunate. Its size, which permitted access through a port, coupled with the fact that it was located farther down in the cone, allowed it to remain outside until six hours before launch.

Monkey Able rested in a semi-supine position and face down during the launching phase so that its back would face the earth during re-entry and absorb the major acceleration stresses.

Its capsule, approximately 41 in. long, included temperature control, pressure control, an oxygen regulation system and a bed of Baralyme pellets to absorb carbon dioxide.

Oxygen was fed into the capsule from two bottles pressurized to about 1,500 lb. Pressure was fed into the unit by a sensing switch which allowed more oxygen in as the pressure inside the capsule dropped. Padded couch consisted of a fiber glass laminate contoured shell padded with a polyeurethane substance approximately one-half inch thick.

The capsule designed for monkey Baker, who also made the flight facing down at launch and in a supine position with knees drawn up, was similar to the unit developed for Gordo, the small squirrel monkey who made a similar flight, but alone, in the nose cone of a Jupiter last December (AW Dec. 22, p. 23). Gordo, however, was not recovered.

The capsule, measuring 9.75 x 12.5 x 6.75 in., contained 670 cu. in. of space available for the monkey, survival and recording equipment and weighed a total of 29.5 lb.

It was insulated with fiber glass and rubber, and oxygen was furnished from a flask equipped with a pressure operating valve.

A Mobilbead absorber removed excess moisture from the atmosphere within the capsule, and, as in the case of Able, the system contained a bed of Baralyme pellets for the removal of carbon dioxide.

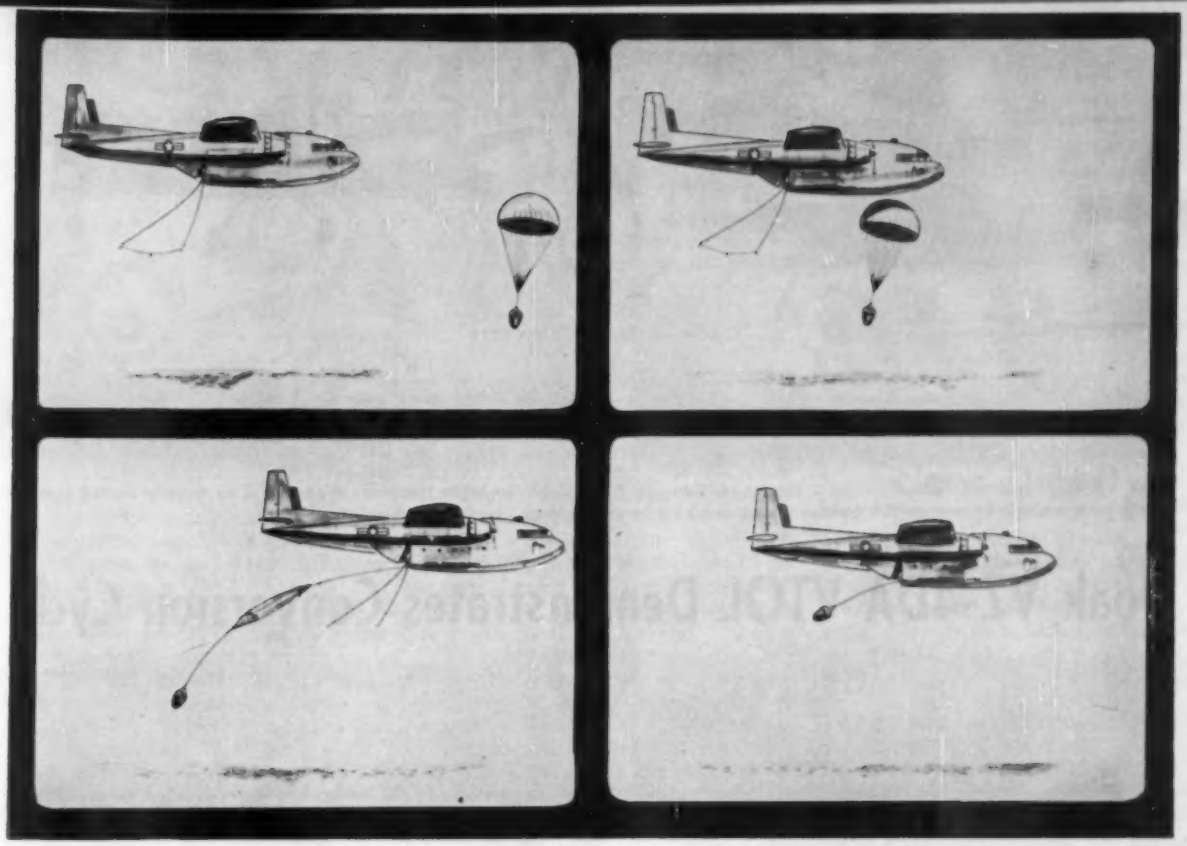
The recovery package used in the firing was developed by Cooke Laboratories, of Chicago, for the Army Ballistic Missile Agency. In operation, deployment of the package is triggered by a deceleration switch.

At a certain stage of the deceleration, the back plate of the nose cone is blown off, and a mechanical timer expels a parachute. At this point, two small bombs also are expelled from the sides of the cone to aid Navy search parties in locating the cone. Three seconds later, a second parachute is ejected to aid in the braking process.

Just before hitting the water, a large red balloon is expelled, carrying with it a light and a small antenna for the recovery transmitter. Once the balloon hits the water, the antenna is ejected and begins to transmit continuous signals that can be picked up by search aircraft for relay to the surface craft waiting to make the recovery. The nose cone itself is attached to the balloon by cable.

Lockheed JetStar Prototypes in Flight

Lockheed Aircraft's two prototype JetStar executive jet transports are photographed together in flight for the first time over northern Georgia. Production models of the four-engine jets are being built at Lockheed's Georgia Division at Marietta, Ga.



DISCOVERER payload is designed to be air-snatched by Fairchild C-119 of 6593rd Test Squadron, Hickham AFB, Hawaii, as shown in drawing. Aircraft will home on recovery capsule's radio beacon which begins transmitting as parachute opens at about 55,000 ft. Below, a practice space capsule is winched into a C-119 during a practice recovery trial over the Pacific Ocean.

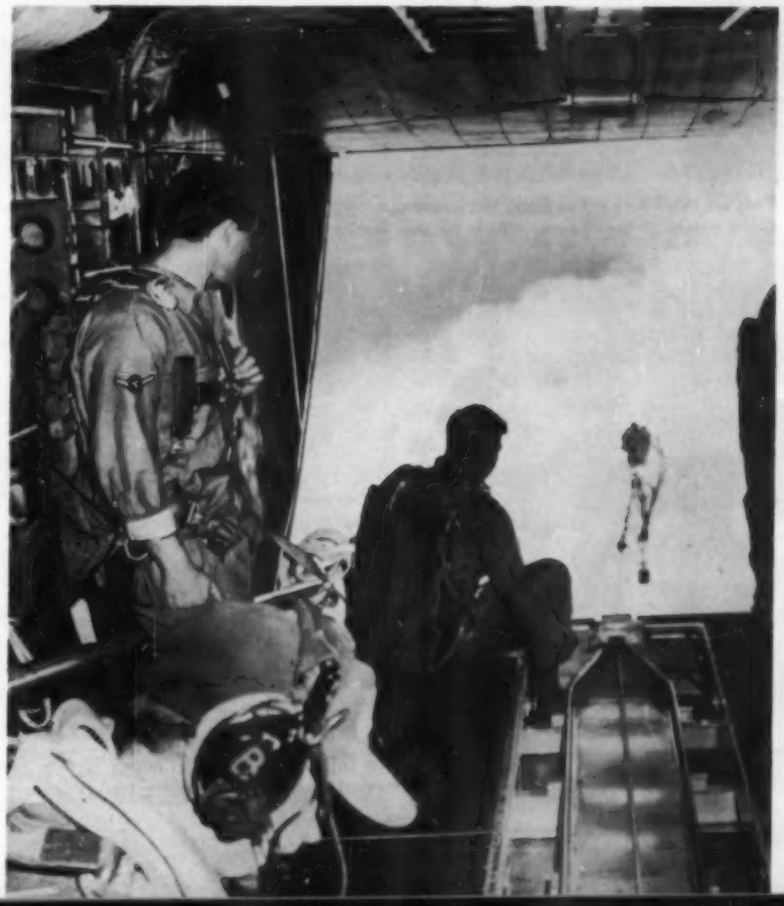
Discoverer III Fired, But Fails to Orbit

Vandenberg AFB, Calif.—Discoverer III blasted off from here last week for what was to have been this country's first attempt to collect biological data on orbital flight.

The experiment was assumed a failure, however, when, 18 hr. after launch, all efforts to track the second stage vehicle had failed. The Thor booster carried the second stage to orbital altitude, separation occurred and the Bell Hustler engine of the Lockheed-built second stage fired, but orbital flight was not attained.

Telemetry data were received at the launch site and by the downrange tracking vessel, but Air Force officials said that when other tracking stations did not acquire the satellite, it was assumed that it re-entered the atmosphere prematurely and was incinerated. They did not believe Discoverer III achieved sufficient velocity for outer space.

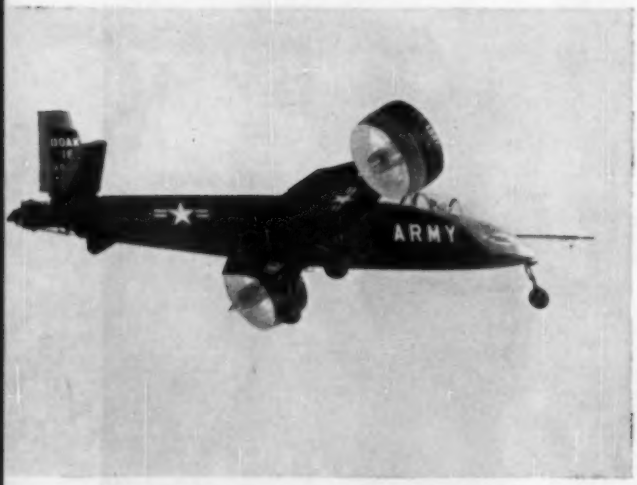
Four laboratory-trained black mice in a 160-lb. recovery capsule were to have provided the first U.S. biological data from orbital flight. Primary interest was in the effect of cosmic radiation. Black mice were chosen because cosmic radiation exposure can cause a noticeable change in hair pigment.

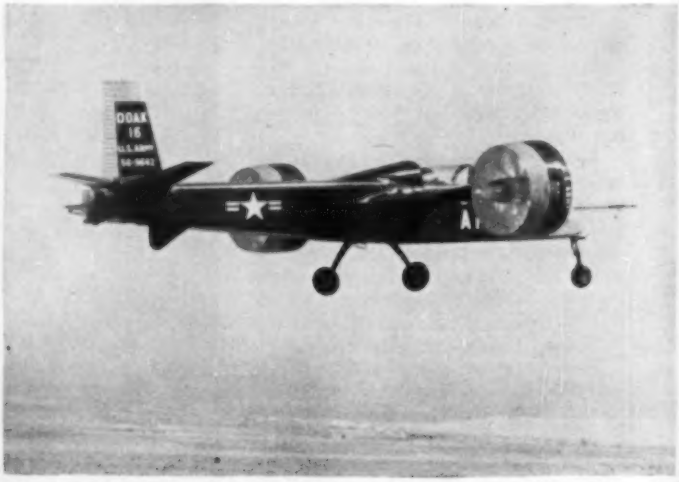


Doak VZ-4DA takes off vertically from a runway at Edwards AFB, Calif., to begin transition sequence. Two wingtip ducted fans are driven from a single Lycoming T53 turbine engine mounted in the fuselage. Intake is behind the cockpit.

Doak VZ-4DA VTOL Demonstrates Conversion Cycle

Fans are tilted forward to begin the conversion cycle. Degrees of tilt are marked by white lines on the inboard side of the left wing fan. Gross weight of the research vehicle for this sequence was at maximum—3,000 lb.





The aircraft reaches forward flight with the fan rotations completed through 90 deg. Conversions have been made successfully at pressure altitudes from 3,000 to 6,000 ft. from forward flight to the hovering configuration.

Boost in Radar Tracking Range By Five-Fold May Be Possible

By Philip J. Klass

Washington—Five-fold increase in the skin-tracking range of radar, which should extend its vision to distances of up to 10,000 mi. against small targets and up to 25,000 mi. against larger targets, now appears possible, Dr. H. G. Weiss of Lincoln Laboratory reported last week during a convention of Armed Forces Communications and Electronics Assn.

In order to track deep space probes, however, the vehicle will have to carry a small radar beacon. For such beacon-equipped spacecraft, Weiss said that radar should be able to track a vehicle to distances of 400-500 million mi. Most likely operating frequency for the tracking radar will be in the 500 to 1,000 mc. region, perhaps centered near 800 mc.

Problem of detecting, tracking and identifying unknown satellites will prove more difficult, Weiss cautioned. He described several possible configurations of large earth-based radars which could detect satellites and make up to 20 measurements of satellite azimuth, elevation position and range during a single pass. Using pulse radar techniques, it should be possible to sort out and keep track of up to 10,000 random space objects simultaneously, Weiss said.

Lincoln Laboratory studies of the satellite detection/tracking problem are sponsored by Air Force's Air Research & Development Command. Under authorization of the Advanced Research Projects Agency, ARDC is to provide a blueprint for a satellite detection/tracking network required to handle anticipated "space congestion" of the future, as well as integrating present facilities for an interim capability.

Col. Lawrence Israel, of ARDC headquarters, said the agency hopes to have approximately $10 million available in Fiscal 1960 (half of it in ARPA funds) to continue its investigation of the problem and to sponsor required state-of-the-art developments. Eventually, the operation of the military satellite tracking network will be transferred to a USAF operating command, but the choice has not yet been made.

National Aeronautics and Space Administration's first experimental passive communications satellite, scheduled for launching by early 1960, will operate two-way radio propagation tests between Goldstone, Calif., and New Jersey using a frequency of 2,000 mc. for the west-to-east transmission and 1,000 mc. for the east-to-west transmission, NASA's Leonard Jaffe told the AFCEA convention. Jaffe also discussed the possibility of setting up a "chaff belt" around the earth which would serve as a stationary reflector of radio signals. However, he said that considerable study and work are required to establish the feasibility of this approach.

One reason that the Defense Department is pushing development of active communication satellites, while NASA develops passive types, is that the former requires only relatively small earth-bound antennas and transmitters as compared with those needed for passive communication satellites, ARPA's Dr. Samuel Batdorf said. This makes it easier to harden such earth-based sites to make them less vulnerable to bomb blast, Batdorf said.

To make military communication satellites relatively resistant to enemy jamming requires that the active satellite avionic equipment be capable of extremely broadband operation. A 100:1 increase in bandwidth can be obtained if the antenna of a "hovering" satellite at 22,400 mi. altitude can be continuously oriented so that it is aimed at the earth station, compared to an omnidirectional (unoriented) antenna, Batdorf said. For ground-air communication, with the satellite in a 5,000-mi. orbit, a 10:1 gain in bandwidth can be achieved through continuous orientation of the satellite antenna, Batdorf said.

By 1962, larger rocket boosters should make it possible to increase transmitter power of deep space probe vehicles by a factor of 1,000 from the present 0.1 watt to 100 watts, Dr. Eberhart Rectin of Jet Propulsion Laboratory predicted. This, coupled with ability to use larger, higher-gain antennas on the vehicle and the use of Maser amplifiers at the earth station, should permit better than a 100,000:1 improvement in the information bandwidth that can be transmitted from a lunar probe. Rectin predicted that information bandwidths greater than 10 mc. should be possible for a lunar vehicle, with a figure of 0.3 mc. for a Mars probe vehicle.

Cost of generating electric power aboard a satellite or space vehicle using silicon solar cells, at current prices, can run into millions of dollars, Dr. Nathan Snyder of ARPA told the convention. Cost of providing 200 watts electric power continuously, using stationary cells that do not automatically orient themselves to face the sun, can cost $1.8 million if the vehicle is in the earth's shadow 50% of the time, or $600,000 if beyond the earth's shadow. However, he said that the price of silicon cells is coming down.

Snyder reported that ARPA, NASA and the military services are investigating the complete spectrum of techniques for generating electric power, ranging from fuel cells to solar collectors operating with heat engines, from nuclear cells to thermionic converters. He said that ARPA is studying power sources in sizes ranging up to 20 mw.

Studies include 30 ft. diameter solar collectors, capable of being folded during launch, which would be capable of collecting and focusing up to 250 kw. of solar energy for generation of 25 kw. of electric power.

News Digest

Follow-on contracts totaling $15,181,000 for production of Army Lacrosse surface-to-surface missiles have been awarded to the Martin Co.'s Orlando, Fla., division. Army said a Lacrosse missile brigade now is in training at Ft. Sill, Okla.

Space Recovery Systems, Inc., of El Segundo, Calif., has a contract for the recovery system to be used in conjunction with the crew escape capsules on North American's F-108 and B-70 Mach 3 airplanes. System is composed of electronic components which are incorporated into the capsules, making it easier to locate ejected crewmen.

Army Ordnance has awarded Olin Mathieson Chemical Corp. a $500,000 contract for research and development of a new solid propellant for Nike Zeus. The Nike Zeus propellant is similar to a new solid propellant under study for the Nike Ajax, according to the company, and is not related to Olin Mathieson's high energy boron fuel work.

Short Bros. & Harland's SC. 1 vertical takeoff and landing jet aircraft last week made its longest flight—six minutes—at the company's Belfast, Northern Ireland, airport. Aircraft hovered, flew sideways and backwards and flew forward for ¼ mi. at 30-ft. altitude.

Early warning radar contract for North Atlantic Treaty Organization installations has been awarded to Marconi's Wireless Telegraph Co., Ltd., of Great Britain, and Compagnie Gencrale de Telegraphie Sans Fil, of France. Contract for $19.5 million calls for supply and installation of all equipment in NATO chain. Major portion, about $14 million, went to the British firm.

Western Air Lines' first Lockheed Electra turboprop transport was delivered last week. Flight from Lockheed's Burbank, Calif., facility to Western's Los Angeles base at International Airport took just 5 min.

Locals' Equity Financing Looms as Issue

Guaranteed Loan program is involved in CAB's demand that local carriers broaden ownership.

Civil Aeronautics Board and the local service airlines are flirting with a showdown on an issue they have so far managed to skirt: equity financing of new equipment programs.

The question, which deeply involves the Board's Guaranteed Loan Program, finds New York financial circles supporting the Board's position in some respects, opposing it in others and by no means in agreement.

Six local carriers and one helicopter carrier have had loans approved and four more are in process. These cases focus on what is becoming a major issue:

• **CAB is insisting** in most cases that the airlines receiving the Guaranteed Loans raise additional equity to bring their relatively high debt structure and comparatively low equity structure into better balance.

• **Paradoxically,** the Board while stating this policy in orders granting loans has felt obliged to depart from it at the same time.

The latest case in what has become a series of contrasts is represented by Ozark Air Lines and Frontier Airlines, two of the four applicants for Guaranteed Loans.

Ozark is offering 132,944 shares of common stock for which it hopes to realize $565,012 net to supplement a Guaranteed Loan of $2,118,996 from the City National Bank and Trust Co. of Kansas City for purchase of three Fairchild F-27s and spares, including four Rolls-Royce Dart RDa. 6 turboprop engines from Capital Airlines.

Frontier, on the other hand, reportedly plans to issue debentures which will not have the effect of broadening its equity, much to the Board's displeasure.

However, there is plenty of precedent for Frontier's action.

Debt-Equity Ratio

In approving a $1,305,270 loan to Wien Alaska Airlines from the Bank of New York and the Teachers Life Insurance & Anuity Assn. of America, the Board noted that this would give Wien a debt-equity ratio of 79:21. The Board said it granted the guarantee despite this unfavorable financial structure only because of the importance to national defense to bring modern airlift to northern Alaska and because the new equipment—two Fairchild F-27s—will provide Wien an opportunity to reduce subsidy substantially. But it added:

"We are satisfied at this time it is not feasible for Wien to raise a significant amount of equity. However, we believe that Wien's circumstances are exceptional and we shall continue to expect that other carriers, not so situated, raise needed equity in connection with Guaranteed Loans. Furthermore, we shall expect Wien to be vigilant in seeking to improve its financial position by raising additional equity at the earliest possible opportunity."

Board Comment

In the cases of Piedmont Airlines, Pacific Airlines and North Central Airlines—all involving approvals despite Board warnings on a high debt-equity ratio—the Board called attention to this problem.

The Piedmont order in particular brought this comment:

"We are aware that many of the local service carriers are carrying on their operations with heavy debt structures and that this situation will become more severe if they purchase new equipment by further borrowings. Under our present policy, the Board ordinarily allows these carriers a return based on a standard investment composition of debt and equity, regardless of the actual composition of a particular carrier's investment.

"We recognize that this policy pro-

Guaranteed Loan Box Score

Civil Aeronautics Board has approved seven Guaranteed Loans for local service airlines since the legislation was enacted Sept. 7, 1957. They are, in order of approval:

• New York Airways, granted May 15, 1958, toward purchase of five Vertol H-44 helicopters. Loan total is $1 million at 5¼% interest including .7875% guaranty fee, with the Hanover Bank, the United States Trust Co. of New York and the Federation Bank and Trust Co. as lenders. No equity financing since additional equity probably is not required in this case.

• Bonanza Air Lines, granted June 19, 1958, toward purchase of six Fairchild F-27s. Loan total is $4,324,500 at 5¼% interest including .325% guaranty fee, with the First National Bank of Nevada heading a group of banks as lenders. Bonanza sold approximately $1 million in common stock.

• Piedmont Aviation, Inc., granted Sept. 29, 1958, toward purchase of eight F-27s. Loan total is $4,850,000 at 5¼% including .325% guaranty fee with the Wachovia Bank and Trust Co., Prudential Insurance Co., Bank of New York, the United States Life Insurance Co. in the City of New York and the Gulf Life Insurance Co. as lenders. No equity sold. Debt equity ratio after granting the loan was 78 to 22.

• Pacific Air Lines, granted Nov. 17, 1958, for six F-27s. Loan total is $4,631,000 at 5¼% including .2875% guaranty fee; Bank of America National Trust and Savings Assn. was lender. No equity sold.

• North Central Airlines, Inc., granted Jan. 8, 1959, for purchase of five Convair 340s. Loan total $2,340,000 at 5¼% with a guaranty fee of .375%. Northwestern National Bank of Minneapolis and the Irving Trust Co., New York, lenders. No equity sold; debt to equity ratio after Guaranteed Loan 78 to 22.

• Aloha Airlines, Inc., granted Feb. 25, 1959, for three F-27s. Loan total $2,290,000, at 5.55% and fee of .375%. Continental Assurance Co. and United States Life Insurance Co. lenders. Aloha sold approximately $1 million in subscriptions for new stock along with the loan financing.

• Wien Alaska Airlines, Inc., granted May 19, 1959, for two F-27s. Loan total $1,305,300 at 6% with a .375% fee. Bank of New York and Teachers Life Insurance & Annuity Assn. of America lenders. No equity sold; debt to equity after financing 79 to 21.

West Coast Airlines financed its F-27 purchase through bank loans without recourse to the guarantee. Four airlines, Alaska, Frontier, Hawaiian and Ozark have applications pending. Ozark has offered stock to broaden its equity base.

vides a strong incentive to the carriers to trade on the equity by increasing their debt, particularly since the eligibility for subsidy tends to relieve them of the normal business astringent of bankruptcy. We believe that this is a matter of the most serious concern; and we intend to explore the problem fully in the near future."

The question follows naturally: What can the Board do to enforce its warnings once the loans are granted?

It is doubtful if the Board could take any direct action. Some say, however, that the Board could use subsidy payments as a lever. Others point out the question could influence the Board in route awards. New routes require expense to open and if an airline is heavily loaded with short and long term debt the Board could logically argue the airline is in no condition to handle the cost of integrating the new route.

What has blossomed from this situation is a horse-and-cart question. Some financial sources in New York feel the Board should have first faced the necessity for giving the local service carriers the subsidy they need to become financially sound. And, they continue, if the carriers had the earnings they require the cart wouldn't be needed anyway—that is, there would be no need for a Guaranteed Loan. They feel these airlines could then attract private capital on their own merits.

Some CAB sources tend to agree that the earnings question should have come first, though they do not concede the lack of necessity for the Guarantee. One reason cited for the Guarantee is the necessity of local lines for dealing with banks and insurance companies outside New York, institutions which may not have the resources or experience of the New York institutions in aviation financing.

The objections raised to the Guaranteed Loan by those who oppose it are:

• **Holders of a Guaranteed Loan** will gain a preferred position before the Board. That is, that in a route case or mail pay case, the Board would feel obliged necessarily to safeguard its commitment and thus tend to favor the airline with the Guaranteed Loan against one without.

• **Guaranteed Loans** will relieve a carrier from pressures to take strong measures itself to improve its financial position. For example, this group feels that in the case of many local airlines, the stock is closely held—perhaps by one man—and the Guaranteed Loan will serve as a means of escaping the loosening of that control in broadening an equity base.

This philosophical viewpoint is not shared by all commercial bankers or investment bankers. These tend to share the feeling of the Board and the carriers that the Guaranteed Loan is necessary as a practical step to make lending to the financially weak local carriers palatable to institutions.

Here arises a new area of disagreement between the Board and the lenders. Another segment of the commercial or investment banking fraternity has no objection to the Guaranteed Loan but feels it is inadequate in detail: that the Guarantee is not strong enough legally, that the legislation is poorly drawn, or that the Guarantee should be 100% of the principal of the loan instead of 90% as it is now.

The Board, which fought hard for the measure, resents this criticism, especially any implication that the Board would fail to make good on a Guarantee even though it is not formally stamped with the seal and good faith of the U. S.

One investment banker pointed out where the difficulty lies. If he, for example, undertook to arrange financing for a local carrier, he would begin making the rounds of banks and insurance companies literally trying to sell the loan. Even though the money market is not severely restricted, both types of institutions usually have various alternatives for placing their funds.

What can happen is that the lender, scanning the fine points of the proposals, finds that the missing 10% in the Guarantee—that could look small to the Board viewing the situation from one position—begins to loom rather large. While the good faith of the Board may not be doubted, the perhaps small but still existing drawback as to the legal status of the Guarantee may be enough to tip the decision on the loan to another quarter.

The Transportation Assn. of America is considering a recommendation to eliminate these two gaps. Another proposal, to raise the limit on the Guarantee from $5 million to $10 million is slumbering in Congress and is unlikely to get serious attention this year.

One last area of disagreement between the Board and lenders has been on practical details once the lenders have signed and the final processing begins.

From the lender's standpoint, the processing of the first loans was a long and agonizing affair. The Piedmont Airlines financing, for example, took more than a year.

This is blamed primarily on the newness of the program and the natural lag that ensues in setting up a system of machinery for approval that will prevent possible Board or congressional criticism later.

Another controversy in this area that has left bitterness on the part of both Board and lender has been disallowances on various items of expenses in connection with the loan. In the Piedmont case, the Board called attention to what it felt were high expenses for making the arrangements, though it did not disallow them. In the Wien case, the Board would not allow manufacturer's charges of $145 a day for a 30-day delay when Wien ran into a snarl in completing its final loan papers.

Some financial sources strongly endorse the Board's equity policy and feel the new plan of the Association of Local Transport Airlines may mean a step forward.

Others are unconvinced that getting the local service airlines off subsidy is really a good idea. These sources feel that to take the steps needed—elimination of low density routes, absorption of local routes now flown by trunk lines—would defeat the whole concept of local service. To become subsidy free, they believe, the local airlines would have to become, in effect, regional carriers.

Thus they feel a genuine local service airline might have to be permanently subsidized because the real concept of local airlines is the serving of basically unprofitable route systems.

Ayer Credit Deal

New York—Aircraft dealer Frederick B. Ayer and Associates has received a long-term line of credit from American Express Co. under an agreement which also gives Ayer the use of the express company's world-wide network of facilities. Ayer, whose largest transaction so far has been the agreement to purchase a major portion of American Airlines' piston fleet (AW April 27, p. 42), now can draw on the subordinated line of credit whenever required in solving the financing problems of potential aircraft lease or purchase customers.

The aircraft company will get American Express cooperation in the form of advice when needed on local financial and other matters in any of the 36 countries where American Express's 379 offices are located. Ayer also can use the express company's office facilities and communications network.

Ayer plans to open permanent sales offices in Europe and Latin America.

Boeing 707-320 Flies 5,830 mi. Nonstop

Seattle—Boeing Airplane Co.'s long-range 707-320 jet transport flew nonstop from here to Rome last week, visited a few European airports, and returned to Seattle nonstop from London. The flights were part of Federal Aviation Agency certification tests.

The 5,830-mi. Rome flight was made in 11 hr. 6 min.: the 4,820 mi. from London to Seattle took 9 hr. 38 min.

UNITED'S Douglas DC-8 jet transports' seats (left) have built-in accessories, such as the stewardess call button; reading lamp in upper seat corner focuses where desired. At right is the first-class passenger lounge.

United to Begin DC-8 Flights Sept. 18

Los Angeles—United Air Lines, entering the jet era nine months behind competitors, feels it will suffer no lasting ill effects from the delay, and is glad it waited for the Douglas DC-8 since it believes this airplane is best suited to its needs, according to William A. Patterson, United's president.

Patterson accepted delivery of United's first JT3C-6 (J57) powered domestic jet transport from Donald Douglas, Sr., at ceremonies here last week. The airplane will be operated on a provisional certificate for crew training and route familiarization.

Concerning United's jet timetable, Patterson said:

• **First transcontinental service** will start Sept. 18, following certification of the DC-8. The line will inaugurate jet service with at least eight DC-8s, possibly 12. Dual configuration (first class and coach) seating will be incorporated.

• **Coastal service** between Los Angeles-San Francisco-Seattle may be started in October or November of this year, to absorb "end time" of DC-8s between transcontinental runs. Patterson pointed out that if a DC-8 lands at Los Angeles at noon, and is not scheduled to start back to New York until 5 or 6 p.m., there is ample time to send a flight to San Francisco-Seattle and return, thus increasing the airplane utilization rate and starting service to these areas sooner than if the line waited for more airplanes.

• **Transpacific flights** to Honolulu will be started Jan. 23, 1960, using the domestic class airplane with special provisions for overwater flight.

United's present DC-8 order calls for 18 domestic airplanes with Pratt & Whitney aircraft JT3C-6 engines, a takeoff gross weight approximating 167,000 lb., plus 22 of the heavier (310,000 lb. maximum takeoff gross weight) planes powered by Pratt & Whitney JT4 (J75) engines.

First of the big DC-8s will be delivered in 1960, and will be introduced on the Honolulu flight immediately, Patterson indicated, while the first DC-8s on that run will be operated domestically after the airplane enters service.

United will have 14 DC-8s delivered by the end of 1959, Patterson said.

Noting that United has been planning intensively for introduction of the jets, Patterson said United's flight crews started training in Link simulators last September. In addition, he added that present United plans specify some 20 hr. of simulator time followed by 10 or more hours' flight time.

Questioned concerning the forthcoming transcontinental speed contests which are shaping up among jet transport operators, Patterson said United is sure it can operate its DC-8s to compete, "if we want to." He added, however, that United personnel feel that at present not enough is really known of operating jet transports in the drag rise region at high Mach numbers, and that United presently is planning to stay back somewhat from the limiting Mach numbers.

Patterson also announced the purchase of seven additional Boeing 720 medium-range jets, in addition to the 11 ordered initially in December, 1957. Deliveries on the 18-plane order will start in 1960.

The United president said United has completely financed all jet purchases so far announced, including the seven more Boeing 720s, but indicated that additional financing would be required and would have to be arranged in order to sign contracts for more airplanes, such as the Douglas DC-9, or Boeing's projected model 727.

United still is studying Lockheed's Electra turboprop airplane, Patterson said, and has studied Convair's 880 and

United Considers DC-9

Los Angeles—United Air Lines is "very interested" in Douglas' proposed DC-9 medium-range jet transport, and would definitely buy the airplane should Douglas decide to go ahead with the project, United President William A. Patterson declared here last week. He added that although United cannot now sign a contract for DC-9s, it still assures Douglas of its "deep interest" in the airplane.

Proposed DC-9 would use a scaled down version of the Pratt & Whitney JT3D turbofan (7,000 lb. thrust), or possibly a British Rolls-Royce powerplant of the same thrust class, he added.

Envisioned is an airplane to carry about 70 passengers, able to operate on stage lengths of 300 to 400 mi. or up to 900 mi. nonstop, with a takeoff gross weight approximating 170,000 lb., Patterson said.

Acknowledging that the line has a medium-range airplane in its Boeing 720, Patterson pointed out that there are route segments which United serves where cities could very well be able to generate traffic to support perhaps three flights daily of a 70-passenger plane, where they would not be able to support the required number of flights of a 120-passenger aircraft.

Breakeven load factor on reasonable utilization should be 54%, Patterson said, for the DC-9. Introduction time for an airplane of the DC-9 class, Patterson said, would be 1963. Patterson added that the DC-9 announcement as a firm project could result in fewer orders for 720s than are now planned.

600 jet transports. According to a statement by Patterson, United foresees having 120 jet aircraft in its fleet by 1965 and will, of course, retain some piston-engine equipment. With 40 DC-8s presently on firm order, plus 18 Boeing 720s, Patterson said the possible order for lighter jets of the DC-9 or Boeing 727 class could run as high as 50 airplanes over a five-year period. This would leave some 10 or 12 jet planes to be ordered; with the type probably dictated by whatever need appears greatest at the time.

The airline currently operates 184 piston-engine transports, Patterson said, adding that while no buyers are standing in line for piston-engine planes with money in their hands, he foresees no great barriers to disposing of surplus transports of this type, except for the DC-7.

Concerning the general business outlook and financial picture, Patterson said United figures indicate that overall this year, in spite of competition against jets on some runs, United's business is up 4½%. However, he acknowledged that some nonstop transcontinental flights had been curtailed. But between New York and Chicago, he declared, United seems to be holding its own well against the turboprop.

Jet fare surcharges, Patterson said, currently are pegged for United's operations at $10 for the New York-Los Angeles run, $7 for the Chicago-Los Angeles flight and $3 for New York-Chicago. While none has been set up for Los Angeles, a figure between $3 and $7 will probably prevail—perhaps $5.

Patterson pointed out that the surcharge would give the line approximately a 2% increase in revenue, although the company is seeking an over-all 12% increase. He indicated that a CAB examiner recently recommended an 8% increase which, coupled with the jet surcharge, would boost revenues 10%, leaving 2% to gain.

Requirement for the 12% increase, according to Patterson, is the situation which arises when airlines seek additional equity capital, or financing. In the equity situation, he pointed out, the stockholders or stock buyers want a certain return for their money, and he believes the additional 12% would provide the necessary return.

In addition, Patterson said, he believes the current debt-equity ratio of the airline, about 60% debt against 40% equity, should be reversed.

For the future, United projects that over-all air traffic business in 1965 will be twice that of 1957. The company anticipates that business will increase by 14% the first year jets are introduced, will level off at a fairly steady 4% increase per year through 1965. Of this, Patterson said, United expects to gather approximately 19% of the total.

University Study Sees Dim Future For Surplus Piston Plane Market

By Robert H. Cook

Washington—Northwestern University Transportation Center report predicted last week that the value of used turbo-compound airliners will drop to almost "scrap" levels by the end of 1959. The report, drafted after a one-year study that attempts to forecast the used commercial aircraft market over the next six years but drew fire from both the airlines and used-plane dealers.

The study predicts the high, low and average sale price of piston-engine planes replaced by the transition of major carriers to jet equipment based on a forecast of world traffic, operating costs of the different aircraft and the supply of transports on hand. University researchers adopted a "linear programing" technique to arrive at their conclusions and termed the application of the method to predict the "price of a capital asset" as "a new departure."

Two of the largest used aircraft dealers in the country, Frederick B. Ayer & Associates and General Aviation and Leasing Corp., termed the analysis "shocking" and "unrealistic" and questioned the source of the study figures.

Airline comment also was critical. Spokesmen for American, which is currently disposing of a large fleet of Douglas DC-6s and DC-7s at prices far in excess of those quoted by the Northwestern study, contended that the report fails to reflect current prices being realized on surplus planes and fails to recognize the future disposal potential for such aircraft throughout the world.

Both the airline and dealers maintain that it is virtually impossible to place any sales tag on an aircraft on an annual basis for a predicted period as far away as 1965, which the university study attempts to do.

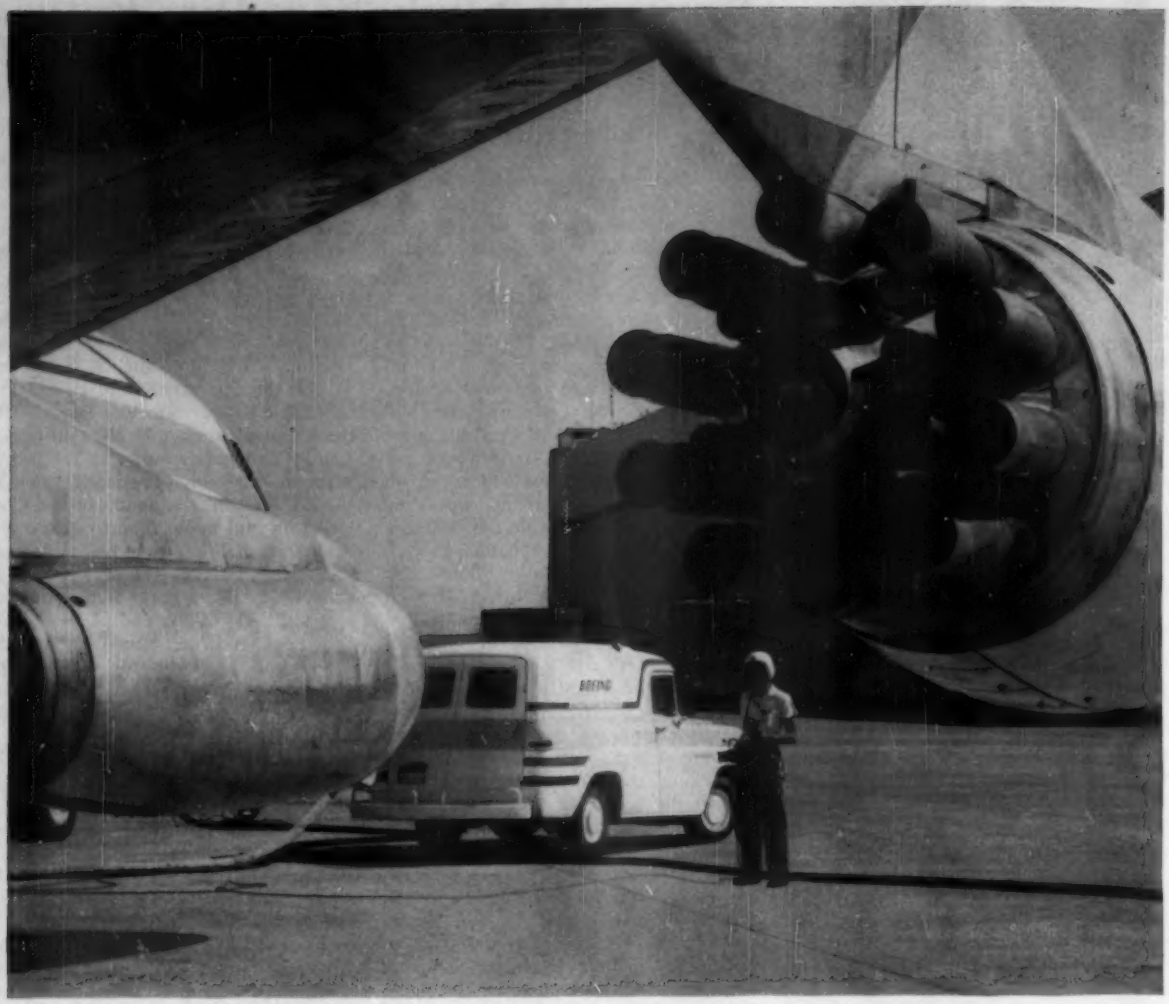
Other objectors point out that a recent study of this problem by United Research, Inc. makes guarded estimates of used aircraft values only as far as 1961 based only on an annual percentage decline in utility.

Of greater importance, they say, is that United's study of the foreign market for second hand planes indicates a need for 469 medium and medium-large transports within the next three years. United Research estimates that there are currently 455 medium aircraft in U. S. carrier inventories at this time and that, to fill the anticipated foreign needs, 95% of this total would have to be released within the next five years.

Involving 17 various models of piston engine aircraft, plus the turboprop Viscount, the university's Transportation Center forecasts that through 1965:

- **Recent turbo-compound models,** such as the Douglas DC-7 and Lockheed Super G and L-1049G and 1649 Constellations will undergo a fast price drop and may be at or near "scrap" value as early as the end of this year, or at least by the end of 1960. Boeing Stratocruisers also were included in this category. The report placed a maximum value of $240,000 on the DC-7, 7B and 7C by the last quarter of 1959. The Lockheed L-1649 also was relegated to the lower price range by the end of this year at a maximum value of $250,000.
- **Smaller four-engine aircraft,** such as the DC-6 and early models of the Constellation and Super Constellation, will decline at a slower pace but will reach scrap level by the end of 1960 or in early 1961. DC-6 prices were estimated at a $120,000 by the end of 1959, with the Lockheeds at $100,000 for the L-049 and $150,000 for the L-1049. United Research places a $343,000 expected price tag on the latter aircraft for 1961.
- **Douglas DC-4s** and DC-6Bs will remain above scrap prices beyond 1965, although their value will decline. Expected prices quoted by Northwestern were a $120,000 average for the DC-4 by the end of this year and $70,000 by 1965. The DC-6B will bring an average of $300,000 by the end of 1959 and only $190,000 by the end of 1961, the report said. The United Research study estimates that this aircraft will be worth $923,000 in 1961.
- **Vickers Viscount 700 series** will decline slowly with an expected average value of $420,000 by the end of this year and $230,000 by 1965.
- **Convair and Martin** transports will remain relatively high through the period with the Convair 240 bringing $310,000 by the end of this year and the -340 and -440 series $390,000. Convairs will drop to $170,000 and $210,000 by 1965 with Martin -404s estimated worth $160,000 by the end of 1959, said Northwestern.
- **Douglas DC-3 will remain** in service but at a price near or at the scrap level throughout the entire period.

Key to much of the price of used aircraft phased out by airlines taking jet deliveries, Ayer contends, is the speed at which the change over to a jet powered fleet is accomplished. He added that a high percentage of piston engine aircraft will be needed well beyond the five-year cutoff of the Northwestern study for such varied uses as crew training, transport of cargo and as spare aircraft.



Leading airlines order

BOEING TURBO-STARTERS

Major airlines, including Delta, Northwest, Pan American, TWA and United, have already ordered Boeing Turbo-Starters to provide fast, economical starts for large jet and turbo-prop engines.

This quiet and versatile Boeing unit, backed by thousands of hours of rugged field service, supplies air to start the largest jet and turbo-prop engines—quickly and economically.

The Boeing Turbo-Starter also provides air for ground operation of alternators, pneumatic systems, and for checking cabin air conditioning and pressurization. It can be used to remove snow and ice from aircraft and related equipment.

Power is provided by the Boeing 502-11B gas turbine, which incorporates all the advantages of Boeing's 15 years of experience in gas turbine research, development and production.

Installation is in half-ton panel trucks for maximum mobility. For complete details, write: Mr. J. C. Anderson, Sales Manager, Industrial Products Div., Boeing Airplane Company, Seattle 24, Washington.

Minetti's Dissents Oppose Higher Fares

By L. L. Doty

Washington—Recent dissent of G. Joseph Minetti in the Civil Aeronautics Board Six Carrier Mutual Aid Pact Case (AW May 25, p. 39) has focused industry attention on this Board member as the latest of the "great dissenters."

Since the first of the year, Minetti has filed a total of 22 dissents climaxed by a 25-page dissension that virtually challenges the majority's legal findings in the mutual aid pact decision. In the recent past, two other members of the Board have stood out as consistent dissenters: Harold A. Jones, a Board member between 1948 and 1951, and Joseph P. Adams, 1951-1956.

Dissension Follows Pattern

On the surface, Minetti's record of dissensions might suggest a maverick relationship toward the Board and its final decisions. His dissensions, however, follow a pattern that offers some basic clues to his underlying philosophy on regulatory matters.

In addition, while his dissensions reveal a strong interest in economic factors, his frequent failure to take part in route certification cases suggest an equally strong lack of interest in route construction.

Since January, he has taken no part in nine route cases that have been decided by the Board. Whatever his reason for abstaining in these cases, they are the only cases thus far this year in which he is on record as not having participated.

He did vote in the recent Pacific Northwest Local Air Service Case but took no part in the significant Chicago-Milwaukee-Twin Cities Case (AW June 1, p. 41) which drew concurring and dissenting opinions from Vice Chairman Chan Gurney and member Louis Hector.

He did not vote in the Intra-Alaska Case, the Kanab-Page-Glen Canyon Area Investigation, Great Lakes-Southeast Service Case opinion and order or in the first and second supplemental opinions in that case.

Last year, he took no part in the original decisions in the Seven States Case, Great Lakes-Southeast Case or the investigation of service to Winston-Salem and Greensboro-High Point. He did participate in the St. Louis-Southeast Service Case but filed a dissension. He voted with the majority in the Dallas-West Coast Service Case.

Minetti also added to his record a dissent against a Board opinion granting an exemption to Trans-Texas to overfly Victoria and Corpus Christi. However, the vast majority of his dissensions against the majority appear to fall into four chief categories which would indicate he holds these positions as reasons for his dissents:

- **Opponent of any fare increases** or the addition of surcharges. His dissents in this area may provide some hints as to how he will vote in the General Passenger Fare Investigation.
- **Champion of overseas charter flights.** Minetti's dissents against the majority decisions denying exemptions for certain charter flights suggest he supports this type of service as an essential facet of international transportation.
- **Opponent of high subsidies.** Minetti is a consistent dissenter against any rate of return on investment for local service carriers that is higher than 8% until a decision in the Local Service Carriers Rate of Return Case is reached. His seven dissensions against the majority's 9½% rate of return in cases handled thus far this year point to opposition of the proposed 10.6% rate of return recommended for trunklines in the recent examiner's initial decision in the fare case.
- **Sensitivity to antitrust** violations is manifested in his dissents. Minetti has a background as special assistant to three U. S. attorney generals in the Antitrust Division.

G. JOSEPH MINETTI

Washington—G. Joseph Minetti, 52, was appointed to the Civil Aeronautics Board by President Eisenhower in 1956 as a member of the Democratic minority on the five-man Board. Between 1954 and 1956, he was a member of the Federal Maritime Board. Previously, he had practiced law in Brooklyn with the firm of Danahy, Delaney & Minetti and served as commissioner of the New York City Board of Transportation and as executive assistant to the Deputy Mayor of New York.

From 1947 to 1950, he was commissioner of the Department of Marine and Aviation of New York City. During World War II, he served in the U. S. Army in the Counter Intelligence Corps in Europe. He has served under three U. S. attorney generals as a special assistant in the Antitrust Division. A native of Brooklyn, Minetti was educated at Fordham University and St. John's University of Brooklyn where he received his law degree.

On the fare issue, Minetti opposed a slight upward fare increase of international tariffs filed by the International Air Transport Assn. for the western hemisphere. He dissented against a Board decision to suspend a tariff calling for reduced fares between Seattle-Portland and Anchorage-Clear, Alaska.

He supported the 25% reduction in "off-peak" coach rates between Boston and Miami which Vice Chairman Gurney opposed on grounds that the rates were not "sufficient to recover costs of the service rendered."

He dissented against the majority's approval of a jet surcharge on first-class domestic flights because the General Passenger Fare Investigation indicated "an industry anticipation that unit costs for jet aircraft will be appreciably lower than current unit costs for piston driven aircraft."

He also noted that the surcharge, coupled with other fare increases and adjustments, would increase rates 17% above the fare level effective prior to January, 1958, and he compared that amount with the 15% average fare increase requested by the industry in the fare case.

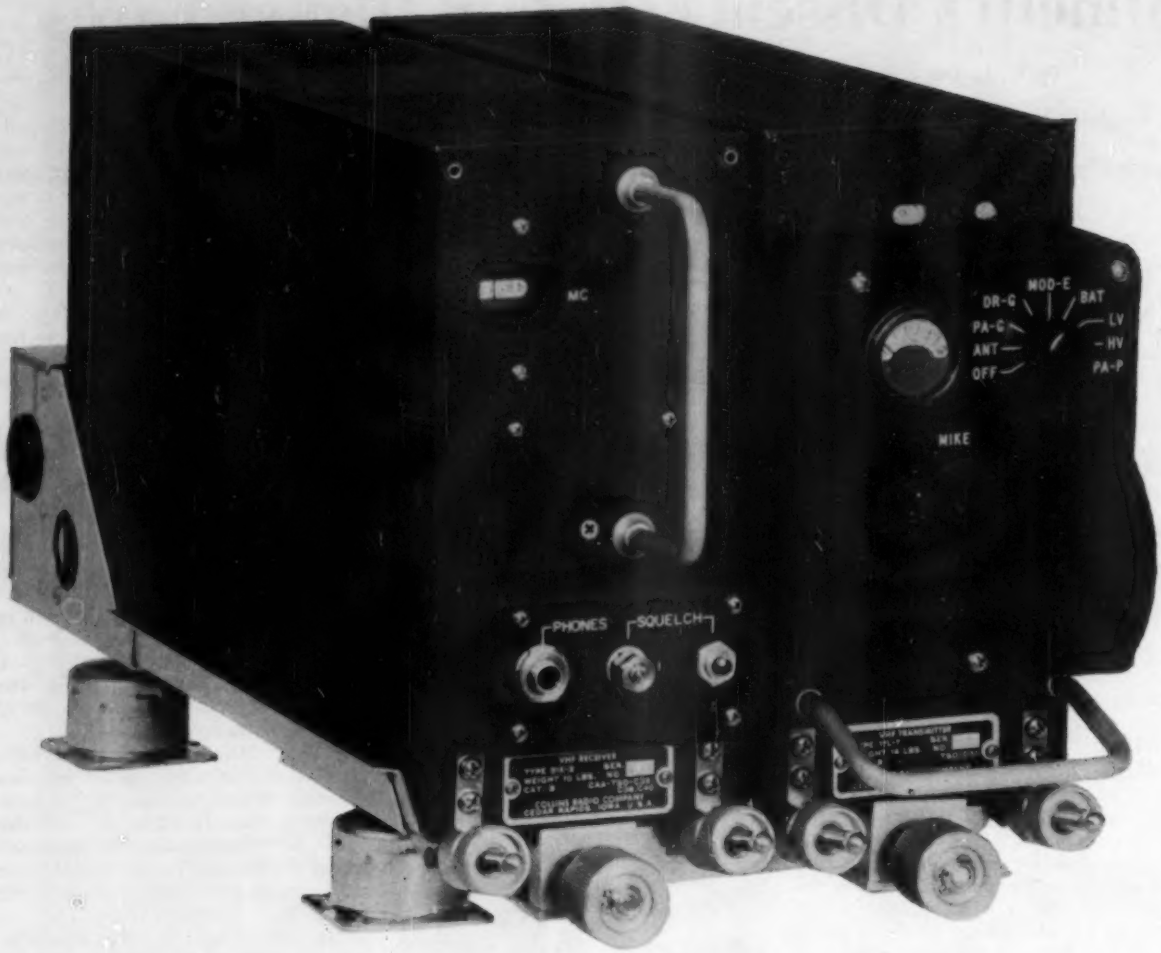
In the same case, member Louis Hector not only supported the first-class surcharge but said he saw no reason why a surcharge should not be applied to coach traffic.

Later, the Board approved surcharges for both types of travel.

Charter Advocate

In the overseas charter field, a majority ruling denying an exemption to operate a charter can almost inevitably be expected to draw a dissension from Minetti. Since Jan. 1, he has filed six such dissensions urging more liberal treatment of charter requests. In several cases during the past year, his dissensions have resulted in a reversal of the Board's original order.

Last month, Minetti used a dissension in a transatlantic charter flight ruling to criticize the Board. The requested exemption for the flight was



the most popular pair since Wilbur and Orville

Already in wide use by airlines and business fleets, Collins 51X-2 Receiver and 17L-7 Transmitter are the overwhelming choice of the airlines in the new jet and propjet transports now flying or under construction. This popular pair meets jet age demands for increased reliability and simplified operation in reduced size, lightweight airborne equipment.

The Collins 51X-2 Airborne VHF Receiver covers the 108.0 to 151.95 mc range, providing 880 crystal controlled channels for VHF communication, VOR, LOC and TVOR reception. The companion unit, the 17L-7 VHF Communication Transmitter, provides 680 crystal controlled channels with 50 kc spacing in the 118.0 to 151.95 mc range, 25 watts output.

COLLINS

COLLINS RADIO COMPANY • CEDAR RAPIDS, IOWA • DALLAS, TEXAS • BURBANK, CALIFORNIA

denied by the majority because of alleged misrepresentations made in 1957, prior to the application for the charter in question.

Minetti, in his dissent, wrote that "since the current misrepresentation is no more material than the past, it does not detract from the charter-worthiness of the group." He added:

"I am puzzled, moreover, that the Board should take this time and method of advising the charterer of its dissatisfaction with 1957 representations. The matter should have been discussed and resolved when it arose in 1957. . . ."

In his dissensions against the grant of a 9½% rate of return on investment for local service and helicopter carriers, he has been joined by Hector on several occasions. Generally, Minetti's reasoning for these dissensions reads similar to this:

"I cannot agree to allowing this carrier a 9.5% rate of return on investment prior to a resolution of that question in the pending Local Service Carrier Rate of Return Investigation."

His philosophy on subsidy is summarized in this extract from a dissent in a New York Airways order:

"Proper exercise of our stewardship of public funds dictates that we provide helicopter operators with a higher subsidy rate of return only where an evidentiary foundation establishes the necessity and propriety of doing so."

Minetti also dissented against a majority opinion in the Delta-Chicago & Southern Reopened Mail Rate Case and wrote that the amount of mail pay paid to C&S should be reduced by $2,347,000 rather that the $1,795,000 found excessive by the majority.

His consistent alertness to any moves which may invade the prohibitions of the antitrust laws is manifested in his dissension against a majority order authorizing Delta Air Lines to join with other carriers for the purpose of discussing the rounding-out of fares to even-dollar amounts. And in his classic dissension in the Six Carrier Mutual Aid Pact case, he refers to antitrust implications in the aid agreement by noting:

"Such questions are always present where competitors agree to share excess earnings. Sharing profits with a competitor, like playing marbles 'for fun' rather than 'for keeps,' is entirely inconsistent with the concept of vigorous competition between rivals. The carriers have been certificated to compete with, not subsidize, each other."

It is this strong stand against the majority opinion in the mutual aid case that has spotlighted Minetti in recent weeks. In no instance, throughout the dissension, does Minetti state that the majority's findings are illegal or that their decision actually violates the Railway Labor Act.

In his conclusion, Minetti calls for disapproval of the agreement "as adverse to the public interest." Earlier, he writes that ". . . we cannot approve this agreement as not in violation of the Federal Aviation Act, the Railway Labor Act, or in the public interest in either, if it permits, encourages or results in carrier activities which violate either statute" and then adds:

"In the absence of information responsive to the many questions arising under this agreement, we must disapprove it."

However, he pulls no punches in his criticism of the agreement. For example, he writes that it imposes coercion on labor and is "premised in a proposition repugnant to the Railway Labor Act." He charges the agreement is "contrary to the objectives of the Railway Labor Act" in that it imposes compulsory multi-employer bargaining without employe consent and substitutes reliance on economic force for good-faith bargaining.

He notes that agreement, "in threatening economic warfare unless employes accept any and all Emergency Board findings, amends the Railway Labor Act's statutory plan in a manner which, from an employer's point of view, is just as effective as the elimination of the statute."

Minetti is equally critical of the Board in the dissension and writes:

"Here, in spite of a prima facie indication that the agreement is repugnant to the purpose of the Railway Labor Act, the majority has granted its approval, not on an insufficient record, but in the total absence of any evidentiary record. In addition, this deficiency is aggravated by the fact that bureau counsel, normally the sole spokesman for the public interest, has neither participated in oral argument nor filed a statement of position."

Boeing Completes 50th 707

Fiftieth Boeing 707 off the production line at Renton, Wash., is American Airlines' 17th 707-120. Previous deliveries of the turbojet transports have been as follows: Pan American, 8; Trans World, 14; Continental, 3; Qantas, 3; BOAC, 1; Braniff, 1, and USAF, 3.

FLIGHT demonstrations in Europe of the Vickers Vanguard turboprop transport are being supported by all-day ground presentations.

Vanguard Tours Europe in Sales Drive

Weybridge, England—Vickers has launched a slick, comprehensive sales presentation in Europe for its Vanguard turboprop transport.

Each presentation is based on a flight demonstration with the Vanguard and a full day's ground session backed by a film and slides. Presentations are being made in Germany, Belgium and Italy, the aircraft returning to base each day.

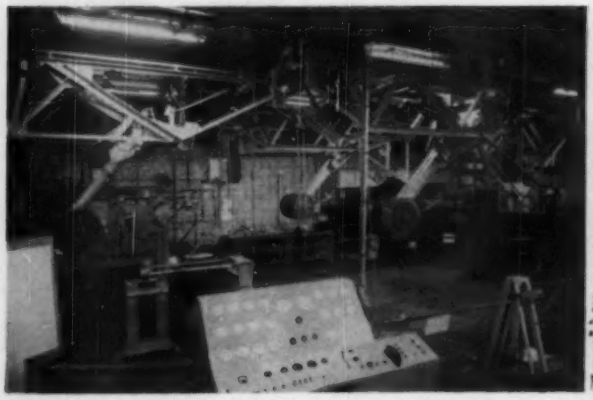
The ground presentation is divided into two sessions, the morning session being occupied with a detailed survey of the engineering and introduced by a film showing design, production and ramp handling details. This session also includes a flight test report.

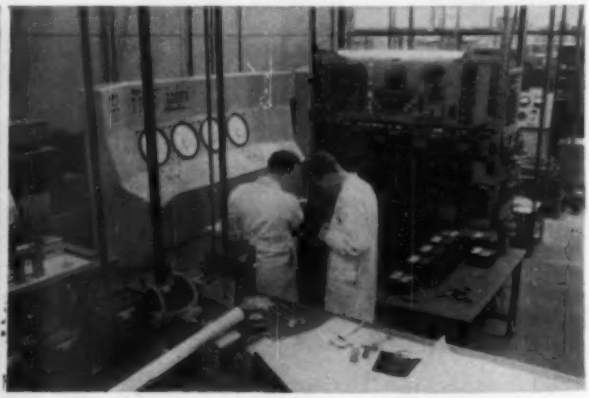
The afternoon session is devoted to a completely detailed analysis of the economic and operational features of the aircraft.

The thoroughness and well rehearsed character of the routine was made evident to AVIATION WEEK during a run-through of the presentation during the annual Viscount operators' conference at Weybridge.

Each presentation is introduced by a full director of the program. Speakers in the sales teams are all designers with flying experience. They stick to a standard format, prearranged according to the country in which the presentation takes place. The operational statistics and graphs are oriented around the operational bases of that country. Speakers are switched to suit different audiences. Both sessions move briskly and are heavily illustrated with the aid of a Vickers slide projector which is remotely indexed by the speaker himself at about one slide per minute.

The presentation seeks to prove that "turboprops in general are not the poor man's jet" and to establish that the Vanguard has the lowest operating costs of any aircraft. The basis of its claim to seat mile costs of one cent per passenger mile for a large portion of its range band are explained. Emphasized is the cost insensitivity of the aircraft when diverging from its optimum cruising flight. Vickers says that over ranges of about 500 mi. the cost penalty for the aircraft when cruising





ACTION of all three wheels of the Vanguard undercarriage is simulated (left) in Vickers test rig. A total of 15,000 flight cycles will be automatically programed. Vanguard electrical installation test rig (right) will be run continuously for five years of debugging.

in the 10,000 to 20,000 ft. band does not exceed $44.

The company also seeks to deny any speed advantage enjoyed by jets over this distance.

Vickers believes the Vanguard will prove well timed in the face of the current cheap fare movement in Europe. The presentation points to the fact that air traffic increased 50% when BEA introduced its cheap fare on the London-Glasgow service. This, Vickers says, is indicative of the greater importance of lower fares over reduced block times in the airline business.

Flight tests at Vickers report very favorably on performance to date, with serviceability much better than had been expected.

The company has two new fully instrumented flight aircraft in the program. The first aircraft, now grounded for installation of resonance equipment, has collected 119 hr. in 52 flights, the second aircraft—the No. 1 BEA machine—37 hr. in 27 flights.

Flying has so far been without incident. Modifications include a dorsal fin now being fitted. The need for a dorsal fin was threatened in some later wind tunnel tests but Vickers hoped to get away without it. Besides this modification, some early development was required to improve the response rate of the nose wheel and there was a need to boost the effectiveness of the ailerons at critical takeoff speeds due to the low rate of roll in this speed band. An immediate modification has been an increase in tab power and the installation of vortex generators on the upper wing surface.

Capt. Dick Rymer, Vickers senior experimental pilot, told AVIATION WEEK that the Vanguard had demonstrated considerably better characteristics in the pitching plane than the Viscount and was a "delightful" aircraft to land both by day and night.

Stalling behavior had not been fully investigated but even down to 75 kt. no tendency had developed for the aircraft to drop a wing when close to the stall—a feature of the Viscount. The aircraft also had the advantage of more stall buffeting than shown by the Viscount. Rymer maintained that the Vanguard was considerably quieter than the Lockheed Electra and was even quieter than the Viscount. Conversion from the Viscount would present few problems, said Rymer, due to similarity of the two aircraft and the closeness of their landing and takeoff speeds.

The aircraft has been getting off the ground in less than 1,200 yd. at its gross weight of 141,000 lb. So far the maximum indicated air speed has been restricted to 270 kt. until flight resonance tests have been concluded. The first aircraft is currently being equipped with the resonance equipment and Vickers thinks it will be clear of this phase of the flight program within 50 flying hours. Maximum indicated sea level speed of 370 kt. will be approached in increments reducing from 20 kt. The aircraft has already been able to demonstrate its maximum cruising true air speed of 425 mph. at 25,000 ft.

Aircraft No. 3 will be instrumented for tropical trials and the fourth aircraft will be used for winterization trials followed by route proving.

By March next year Vickers hopes to have logged 1,290 hr. with five aircraft in the test program and to be ready for certification with the exception of route proving.

Recording equipment is based on photographic recording and trace recorders although some magnetic tape equipment may be used later. In general, one Vickers spokesman said, magnetic tape recording techniques were too expensive for any single British aircraft company. He maintained that it was a superior system but there was a tendency to overdo it in the United States which led to considerable loss of flexibility due to the time needed to reduce the data.

VANGUARDS four, five and six are in final assembly at Vickers' Weybridge plant. Third Vanguard's 5,500 eshp. Rolls-Royce Tynes are being installed on adjacent line.

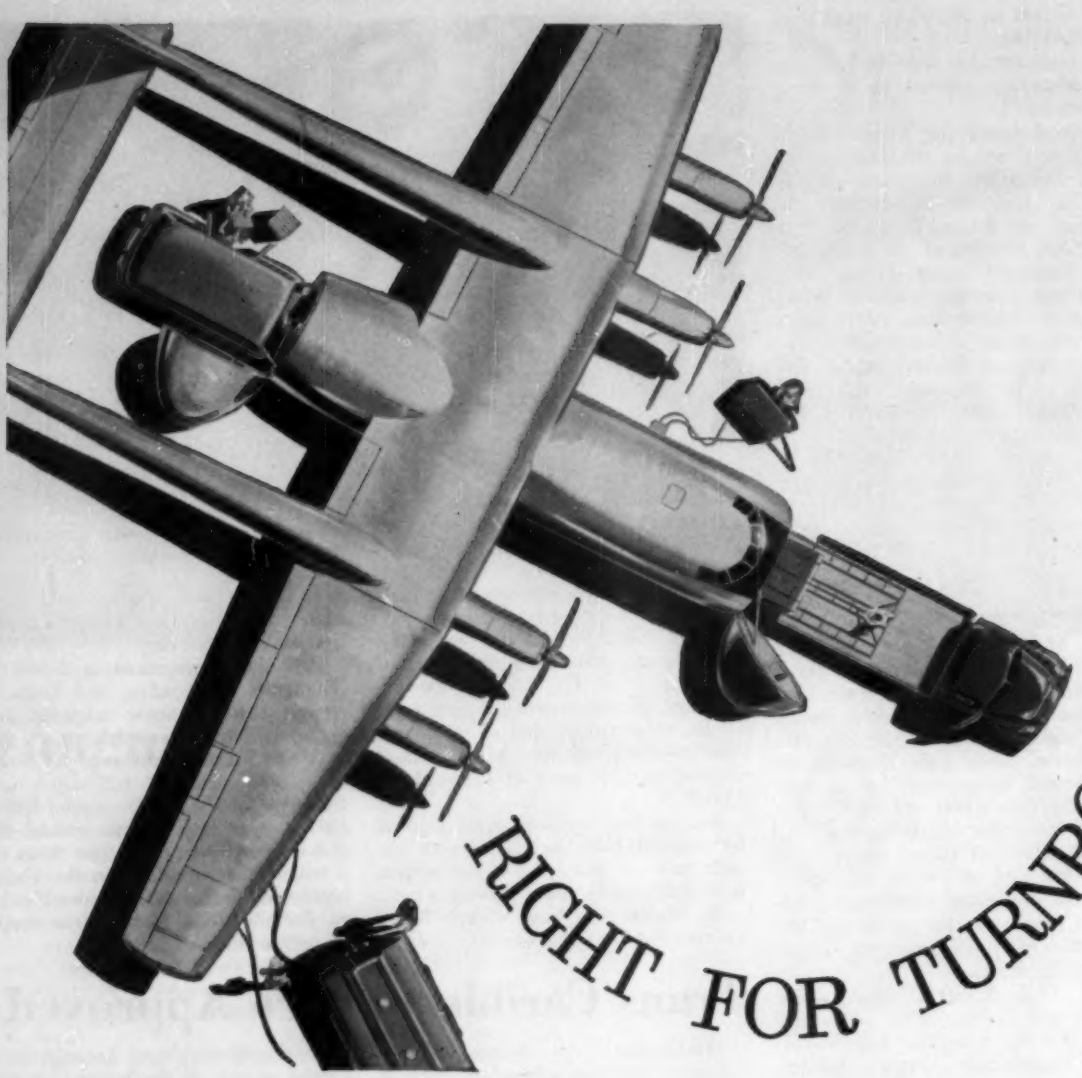
Trans Caribbean Fare Approved

Washington—Civil Aeronautics Board last week approved a new fare discount plan for Trans Caribbean Airways which could result in fare cuts ranging from 5 to 10% in the carrier's round-trip fare between New York and San Juan, Puerto Rico.

The Board, by a four to one vote with Vice Chairman Chan Gurney dissenting, denied objections filed by Eastern Air Lines and Pan American World Airways, and allowed Trans Caribbean to offer a 5% discount to passengers departing from either city for a return flight on Monday, Tuesday, Wednesday or Thursday within a one-year period and 10% on the same departing days if the round-trip flight is accomplished within a 16-day period. The discounts would not apply to first-class fares but would be applicable to lower class fares such as Trans Caribbean's current thrift flights which are now $45 one way.

Pointing out that the CAB calendar calls for a hearing on the entire thrift and tourist fare question in the Caribbean area this week, Gurney urged that Trans Caribbean's new discount be included as part of the hearing, instead, and cautioned against a further reduction in the "lowest per mile rate of any fare in the country" without first determining the effect such a move might have on the profits of competing carriers.

Shortly after Trans Caribbean's $45 fare was approved last year by the Board, Eastern and Pan American were granted increases in their first and second class fares over the same route. When CAB voted last July to investigate the fare situation in the Caribbean area, member Harmar Denny noted that, within less than 30 days after the Board authorized the fare increase for Pan American and Eastern, the two carriers filed tariffs reducing their thrift class fares from $52.50 one way to $45. Denny said that, although the carriers had cited a financial need for the fare increase, it later appeared that the higher fares may have been utilized as a "subsidy" to support the competitive cut in thrift class service.



RIGHT FOR TURNROUND

BIG FORE-AND-AFT DOORS AT PERFECT LOADING HEIGHT ENABLE THE ARGOSY TO LOAD AND UNLOAD WHOLE CARGOES IN UNDER 20 MINUTES

The less you handle cargo the cheaper the transport operation. This is true particularly of air freight where quick turnround is essential if costs are to be kept to a minimum. With the Argosy (AW650) a loading system is being developed that will enable the huge freight hold to be cleared and filled again in a few minutes. With full-width doors at either end of the fuselage, the load can be discharged at one end while new cargo is being loaded at the other.

High pressure refuelling ensures that a turnround can be completed in under 20 minutes. If the Argosy is used for mixed traffic—a role for which it is particularly suited—passenger and freight loading take place simultaneously.

The use of well proven components, particularly the Rolls-Royce Dart prop-jets, promise exceptional utilisation for round-the-clock operations.

PERFORMANCE

POWERED BY 4 ROLLS-ROYCE DART PROP-JETS

AIRCRAFT CRUISING SPEED: (14,000 r.p.m.) 296 m.p.h.
MAXIMUM PAYLOAD: 27,000 lb.
RANGE WITH FULL FUEL RESERVES AND 20,000 lb. PAYLOAD: 1,000 st.m.
SIZE OF HOLD: 46 ft. 6 in. (14.23 m.) x 10 ft. (3.05 m.)
FLOOR AREA: 426 sq. ft. (39.6 sq. m.)

THE ***Argosy*** BRINGS THE COST OF AIR FREIGHT DOWN TO EARTH

DESIGNED AND BUILT FOR THE HAWKER SIDDELEY AVIATION DIVISION BY SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD

SHORTLINES

▶ **Aeroflot,** the Soviet state-owned airline, estimates that by 1965 between 70 and 75% of all passengers traveling between large cities over 621 mi. apart will go by air. Private auto travel in the Soviet Union is an insignificant factor in inter-city transportation and probably will remain so for a long period of time.

▶ **American Airlines** has added two Lockheed Electra first-class flights on its Washington-Chicago route. New schedule calls for departures from Washington at noon and 6:30 p.m. in addition to the 8:55 a.m. and 4:35 p.m. flights now in effect. American also has added a Douglas DC-7 flight to Dallas from Washington, departing at 7:35 p.m. and arriving in Dallas at 10:25 p.m. All times are local.

▶ **Canadair 540** turboprop versions of the Convair 440 have completed an 80,000 mi., 10-week flight demonstration circuit in North and South America. The two aircraft carried a total of 4,139 persons on demonstration flights during the period.

▶ **Chicago Helicopter Airways** reports that preliminary May traffic figures indicate that it carried between 17,000 and 18,000 passengers during the month.

▶ **Continental Airlines,** with inauguration of Boeing 707 Chicago-Los Angeles service scheduled to begin today, says it is spending some $750,000 for jet training of flight and ground crews. Included in the cost is a jet engine trainer costing $76,000.

▶ **Federal Aviation Agency** Administrator Elwood Quesada is taking jet transport training at the Air Force Boeing KC-135 school at Castle AFB, Calif.

▶ **International Air Transport Assn.** reports that Sudan Airways has joined the association as its 88th member airline.

▶ **Panagra, American Airlines,** Delta, National and Pan American World Airways have joined in a transcontinental interchange agreement to provide daily Douglas DC-7 flights from Los Angeles to Dallas, New Orleans and Miami, connecting there with Panagra's 10 p.m. flight to Panama, Ecuador, Peru, Chile and Argentina.

▶ **UAT French Airlines** and LIBIAVIA Libyan Aviation Co. have signed an agreement which provides for UAT-owned Douglas DC-6B aircraft to operate twice weekly service over LIBIAVIA's Tripoli-Athens-Ankara route.

AIRLINE OBSERVER

▶ Watch for an order by Iberia Air Lines of Spain for a fleet of three turbojet transports, probably the Convair 880. Jose Antonio Suances, director of the government-controlled Instituto Nacional Industrias (I. N. I.), has been in the U.S. with a team of technicians analyzing turbojet equipment available for delivery late this year. He also is reported to have completed negotiations for a Reconstruction and Development Fund dollar loan to cover in part the purchase price of three aircraft. I. N. I. will loan the carrier the balance it needs. Iberia filed a letter of intent with Douglas Aircraft Co. last year for DC-8 turbojet transports but apparently now feels the Convair is better suited to its requirements on the mid-Atlantic route. The carrier plans to begin its jet service in early 1960 to meet anticipated competition on its routes.

▶ **Civil Aeronautics Board will impose heavier sanctions in dealing with violations of Civil Air Regulations by airline transport pilots than has been necessary in the past. The Board has warned that strict compliance with the regulations is expected because "not only has the number of aircraft increased, but the aircraft are faster and larger, enhancing the general hazards and also the potential magnitude of a single mishap."**

▶ Pratt & Whitney JT3C-6 turbojet engines completed over 50,000 hr. of flying during first six months of operation in commercial service. Total of 25 engines have reached the authorized 800 hr. overhaul time. Here's how the JT3 record compares with the R-2800, which powers the Douglas DC-6, during a comparable period of time. R-2800 engine reached 7,143 hr. operating time per premature engine removal for overhaul compared with 16,667 hr. for the JT3. Aircraft utilization for R-2800 was 4.0 hr. per engine per day compared to 7.25 hr. for the JT3.

▶ **Leningrad is becoming a major traffic hub for new Russian turbojet and turboprop flights. Aeroflot on May 21 inaugurated thrice-weekly service between Leningrad and Vladivostok with 75-place Tu-104's. The 5,000-mi. route between USSR's two largest seaports is covered in 13-14 hr. with stops at Sverdlovsk, Novosibirsk and Irkutsk. On May 23, direct service between Leningrad and Adler on the Black Sea coast was started with Il-18 turboprop transports.**

▶ Trans World Airlines is experimenting with three extra first-class seats in its Boeing 707 turbojet operation. One plane has been flying for about a week with this configuration. On the port side of the first-class compartment, normal two-abreast configuration has been converted to three-abreast at three locations by removing a table that normally is between the two seats. TWA says the main idea is to accommodate passengers traveling in groups of three who may prefer this arrangement.

▶ **Civil Aeronautics Board has warned that moves by local service carriers to enter the aircoach market will be examined closely. In a statement of provisional findings on the mail rates of Pacific Air Lines—only local service airline offering coach flights—the Board cautioned that authorization to Pacific for coach flights should not be construed as "an invitation to the local service industry at large to embark upon similar programs."**

▶ Convair will begin its first engineering and maintenance training program on the 880 turbojet transport in July. First class will be composed of Trans World Airlines instructors, key supervisory and line maintenance personnel. The six-week course will be divided into specialist groups: line and power plant, structural and systems, electrical and electronics.

▶ **Military Air Transport Service has awarded supplemental contracts totaling more than $3 million to six airlines for overseas passenger airlift during the months of July, August and September. Call commitments of $692,208 went to Flying Tigers; $71,913 to Hawaiian Airlines; $191,970 to Transocean Air Lines; $289,344 to Alaska Airlines; $609,501 to United States Overseas Airlines and $1,186,071 to Twentieth Century Airline. Majority of contracts cover transportation from West Coast military bases to Japan, Guam and Okinawa. Carriers were selected from a total of 28 bidders.**

THE OFFICE OF THE AIR... a new standard in executive flying

The Canadair-Convair '540'
is powered by
Napier-Eland jet-prop engines.

CANADAIR, Montreal, Canada

CANADAIR CONVAIR 540

JET-PROP EXECUTIVE VERSION

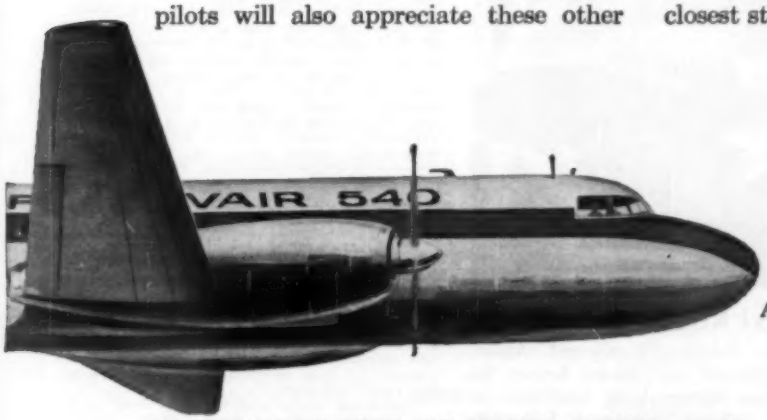
Functional for business purposes . . .
Spacious for prestige executive suites

The Canadair-Convair '540' executive aircraft offers a new major development in business flying: the '540' has *airliner size* that provides roomy work-in-flight office space for as many as 24 people, or ample room for custom-designed executive offices, lounges and staterooms . . . it is *jet-prop quiet* for normal conversation and work . . . it is *fast*, with speeds up to 340 m.p.h., and saves many precious minutes of executive time . . . it is *long-range* and capable of one-stop transcontinental flight.

Company officers and corporation pilots will also appreciate these other important advantages: demonstrably lower cost of operation and maintenance, ability to get in and out of almost any airport, and basic reliability established during the 6,000,000 hours of flying experience of the Convair series in military, airline, and business use.

Behind the '540' stand the manufacturing reputations of two great aircraft manufacturers, Convair and Canadair, both members of the General Dynamics family of companies.

This new 'office-of-the-air' merits your closest study.



Your request for a copy of our brochure will receive immediate attention. Contact R. L. Avey, Commercial Aircraft Sales Department, P.O. Box 6087, Montreal.

Canadair is a subsidiary of General Dynamics Corporation

CA59-540-24 USTA

Salaries Reported by Cargo, Local Lines

Washington—Following is a list of airline officers' and directors' salaries, bonuses and indirect compensations, expenses and stock holdings for the year ending Dec. 31 as reported to the Civil Aeronautics Board:

Seaboard & Western Airlines, Inc.—**R. A. Norden**, president and director, $35,000 salary, 18,776 direct common shares and 22,587 common shares in the name of others; **A. V. Norden**, executive vice president, treasurer and director, $35,000 salary, 27,027 direct common shares and 20,633 common shares in the name of others; **C. D. Brell**, vice president-operations $25,-000 salary, 24,193 direct common shares and 8,910 common shares in name of others; **E. D. Schroeder**, vice president-maintenance, $25,000 salary and no stock; **W. P. Neth**, vice president-traffic, secretary and director, $22,500 salary, 116 direct common shares and 25,897 common shares in the name of others.

W. H. Renninger, vice president-engineering, $18,000 salary and 8,808 direct shares of common stock; **H. Montee**, vice president-Washington, $17,500 salary, 100 direct common shares and 13,202 common shares in the name of others; **A. Thomson**, vice president-commercial services, $15,-000 salary and 313 direct shares of common stock; **J. R. Mahoney**, vice president-industrial and governmental affairs, $15,000 salary and eight common shares in name of others; **S. I. Fondiler**, comptroller, $14,-500 salary and no stock; **J. H. Rosenwald**, vice president-administration, $13,500 salary and 52,179 direct shares of common stock; **D. M. Amann**, director, $4,200 salary (apart from fees paid Lowenstein, Pitcher, Spence, Hotchkiss, Amann & Parr) and 5,800 direct shares of common stock; **C. B. Ripley**, director, no salary, 23,550 direct common shares and 2,412 common shares in the name of others.

Following firms and persons were paid for services rendered during 1958: **Mel Adams & Associates**, public relations counsel, $39,844; **Braunstein & Chernin**, accounting and auditing, $11,800; **Lemberg du Pong**, legal, $5,000; **Lowenstein, Pitcher, Spence, Hotchkiss, Amann & Parr**, legal, $29,621; **Hardy McLay**, legal, $16,530; **Arthur Young & Co.**, auditor, $19,775; **Dixon Speas**, engineering consultant, $26,-715.

Allegheny Airlines, Inc.—**L. O. Barnes**, president and director, $29,125 salary, $2,282 expenses and 23,900 shares of common stock; **W. J. Short**, vice president and treasurer, $16,475 salary, $639 expenses and 250 shares of common stock; **E. K. Arnold**, vice president and secretary, $15,-500 salary, $1,119 expenses and 6,000 shares of common stock; **D. L. Miller**, vice president-traffic and sales, $16,725 salary, $841 expenses and 1,202 shares of common stock; **R. G. Dinning**, vice president, $15,250 salary, $604 expenses, 400 direct common shares and 100 common shares in name of others; **W. D. Hay**, assistant controller, $8,400 salary, $186 expenses and no stock; **G. F. Gerth**, assistant treasurer, $9,300 salary, $222 expenses and 200 shares of common stock; **O. V. Foster**, assistant secretary, $5,200 salary, no expenses and 100 shares of common stock; **J. S. Russell, Jr.**, assistant secretary, no salary, no expenses and 500 shares of common stock.

Following directors were not paid a salary: **R. M. Love**, $52 expenses and 5,000 shares of common stock; **C. Bidelspacher, Jr.**, no expenses or stock; **R. F. George**, $432 expenses and 53,100 shares of common stock; **H. O. Hale**, $29 expenses and 2,500 shares of common stock; **H. R. Hallowell**, no expenses and 1,000 shares of common stock.

P. V. Mattes, $34 expenses and 4,700 shares of common stock; **W. F. Rockwell, Jr.**, $1,402 expenses and 15,000 shares of common stock; **H. A. Satterwhite**, no expenses, 9,075 direct common shares and 3,900 common shares in name of others; **H. R. Sharp, Jr.**, no expenses and 1,700 shares of common stock; **W. R. Waldelsen**, no expenses or stock.

Following firms and persons were paid for services rendered during 1958: **Hale, Stimson, Russell & Nickerson**, legal, $50,-024; **Gotch & Crawford**, traffic and route analysis, $10,159; **Pest, Marwick, Mitchell & Co.**, auditing and tax returns, $5,440.

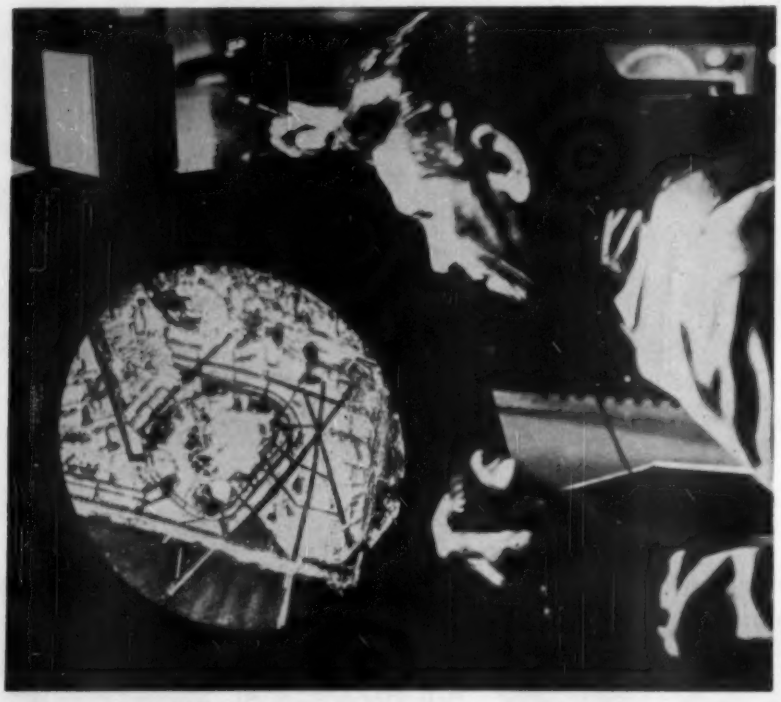
Frontier Airlines, Inc.—**L. B. Maytag, Jr.**, chairman of the board, no salary, 289,-426 common shares and $600,000 principal amount of debt securities; **C. A. Myhre**, president and director, $25,012 salary and 25,000 shares of common stock; **J. D. Lindsay**, vice president, $13,500 salary and 1,000 shares of common stock; **J. A. Love**, secretary and director, $5,000 salary and no stock; **L. P. Blatter**, treasurer, $13,000 salary, 180 common shares and 25 common shares in name of others; **C. Post**, assistant secretary, $4,800 salary and no stock; **E. W. Sexton, Jr.**, assistant treasurer, $8,400 salary and no stock; **L. W. Linville**, director, no salary and 850 shares of common stock; **E. B. Slocum**, director, no salary or stock; **P. Walker**, director, no salary or stock; **J. E. Wagner**, director, no salary and 400 shares of common stock; **B. Regan**, resigned as board chairman 6/1/58, no salary or stock; **E. N. Levin**, resigned as secretary 4/22/58 and as director 6/13/58, $3,336 salary and no stock; **A. J. Frank**, resigned as director, 7/7/58, no salary or stock; **C. Pfeiffer**, resigned as assistant secretary 4/30/58, $400 salary and no stock.

Following firms and persons were paid for services rendered during 1958: **Colin Hugh McIntosh**, economic consultant, $8,-684.88; **Bowen and Scoutt**, legal, $35,516.49; **Rippey, Henderson, Buckman & Co.**, advertising agency, $163,576.85.

Mohawk Airlines, Inc.—**R. E. Peach**, president and director, $30,000 salary, 10,-000 shares of capital stock and $25,000 principal amount of debt securities; **J. R. Carver**, vice president and director, $23,500 salary, 4,018 capital shares and $2,000 principal amount of debt securities; **C. A. Benscoter**, vice president, $23,500 salary, 3,867 capital shares and $5,000 principal amount of debt securities; **T. J. Kirkup**, vice president, $13,000 salary, 1,000 capital shares and $10,000 principal amount of debt securities; **D. E. Postle**, vice president, $13,-500 salary and 600 capital shares of stock; **E. V. Underwood**, director (former treasurer), $4,977 salary and 3,000 capital shares of stock; **F. R. Chabot**, treasurer, $13,500 salary and no stock; **B. C. McLean**, secretary, $9,400 salary and $500 principal amount of debt securities; **R. J. Longwell**, assistant treasurer, $9,000 salary and 12 shares of capital stock; **R. W. Jenkins**, director of flight operations, $16,000 salary and no stock.

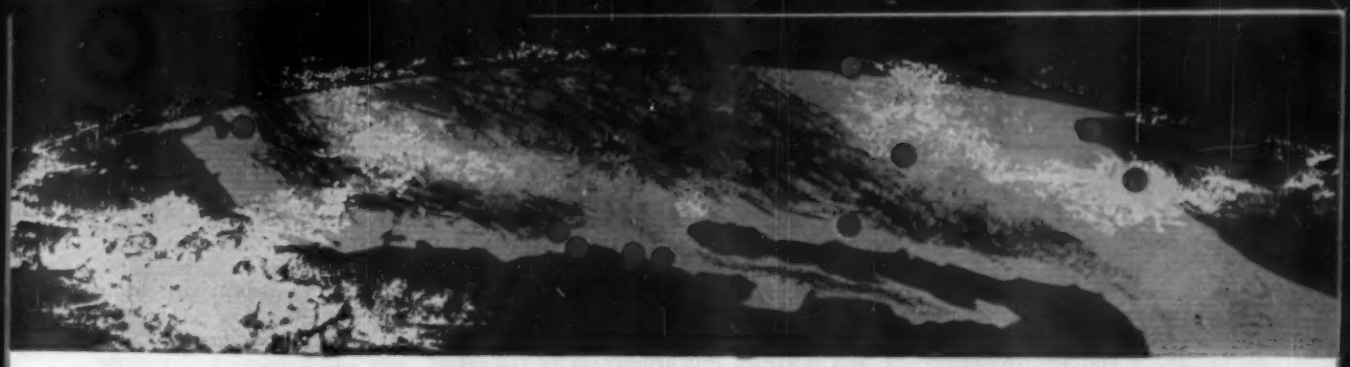
Following directors were not paid a salary: **B. J. Miner**, 133 capital shares; **C. N. Silcox**, 2,000 capital shares and $2,500 principal amount of debt securities; **J. D. Hogue** (deceased) no stock; **W. J. Fields**, 1,000 capital shares; **E. A. Link**, 24,111 capital shares and $125,000 principal amount of debt securities; **P. A. Schoellkopf, Jr.**, no stock; **C. F. Johnson, Jr.**, five capital shares; **J. C. Corwith**, no stock; **W. V. Daugherty**, 500 capital shares and $5,000 principal amount of debt securities; **C. W. Sorrell**, 151 capital shares.

Following firms and persons were paid for services rendered during 1958: **Gilfoil & McNeal**, public accounting-SEC registration systems study, $16,699; **Pogue & Neal**, general legal, $24,985.



USAF, FAA Order Taxi Radars

Follow-on contract for five additional Airport Surface Detection Equipment (ASDE) radars, similar to those shown in operation above at Idlewild International Airport, has been awarded by U. S. Air Force and Federal Aviation Agency, bring total order to 16 units. Contract for $1,518,692, was awarded to Airborne Instruments Laboratory Division of Cutler-Hammer, Inc. Company says scope will show a man walking a mile distant from the antenna.



Where the shape of things to come

is programmed by AMPEX tape recorders

The profiler above is shaping parts for new Lockheed Electras. Exact tool positions are being defined by command signals—as many as 200 per second—from the Ampex FR-100 in the control system to the right of the machine.

The accuracy of such a milling operation increases with the number of points defined per inch of tool motion. One reel of magnetic tape defines millions of points, programming up to 1½ hours of continuous machine operation. Recycling a tape loop will program an entire run of identical work-pieces.

Shaping parts by command signals from Ampex-equipped automatic control systems is now routine production operation at such places as Lockheed in Burbank, Martin at Denver, Rohr at Chula Vista, Convair at Ft. Worth and San Diego, and Giddings & Lewis at Fond Du Lac, to mention only a few.

Even though punched cards and paper tape are still proving adequate for many of today's less-sophisticated automatic control installations, systems engineers are increasingly interested in the superior speed and data-handling advantages of magnetic tape. An Ampex FR-300, for instance, can extract a short burst of digital information equal to that on an entire punched card in less than 4 milliseconds, including start and stop.

In configurations like the one illustrated, the advanced Ampex FR-100A, with its 14 tracks on 1-inch tape, has ample reserve for extra functions. Six tracks may be used for tool-position coordinates; others for start, stop, coolant, or even voice instructions.

Whether you believe the future of automatic control lies in point-to-point positioning, continuous-path control, or both—Ampex magnetic tape recorders have built-in reserve capabilities which make them worthy of consideration as a component for any control system designed for tomorrow's needs.

First in magnetic tape instrumentation

AMPEX
CORPORATION

AMPEX INSTRUMENTATION DIVISION
934 Charter Street, Redwood City, California
Offices in USA and Canada. Engineering representatives cover the world.

Centrifuge Checks Orbital Pilot Stresses

By Richard Sweeney

Los Angeles—Centrifuge tests indicate that acceleration stresses on a pilot during launch and re-entry phases of orbital space flight will permit optimum performance if the pilot is provided with suitable controls and displays.

This AVIATION WEEK pilot participated in a typical orbital acceleration profile which was run in a centrifuge at the University of Southern California here.

Since man's performance under acceleration can be degraded according to the degree of fatigue, the orbital acceleration profile was run at the end of a day in which the pilot had experienced five exposures to accelerations, each exposure consisting of about 30 sec. at 3g, followed immediately by about the same time period at 6g. In all cases the accelerations were transverse, front to back. The subject also had taken a battery of written examinations, so the test was not made under optimum physiological conditions.

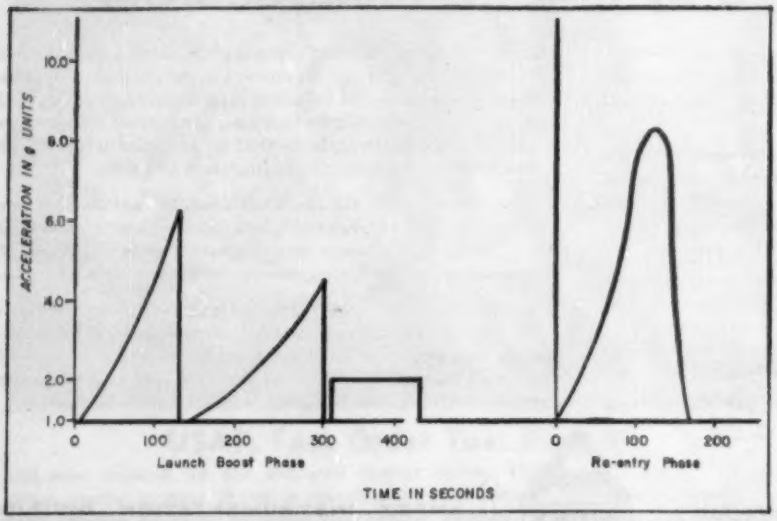
The 3g and 6g accelerations were run as part of an investigation being conducted to determine what degradation, if any, man's thinking and performance undergoes as a function of transverse acceleration. Indications are there that no degradation occurs.

There will be physical stresses other than gravity forces placed upon a human pilot thrusting into space, either in an orbital capsule such as Mercury or in a vehicle such as Dyna-Soar, but provisions will be made for reducing these stresses to the very minimum.

Facilities and equipment used in the centrifuge run included a plywood frame for a seat, with foam rubber seat, back pads and a headrest. Since the chair or pilot seat was in no way contoured, a rolled-up set of coveralls was used as extra support in the small of the back. No special clothing was worn. A throat microphone was worn during all the runs, both in the investigation and the orbital profile. The seat did not incorporate any armrests or other special provisions which would be a part of a space pilot's seat. No pressure breathing or other similar equipment was used.

Total elapsed time of accelerations in the launch phase of this typical orbital profile was 430 sec., of which 30 sec. were spent at rest. The rest period corresponded to the times between burnout of one stage and ignition of another. Re-entry acceleration time was 165 sec.

AVIATION WEEK pilot Richard Sweeney, starting an orbital acceleration profile, is at rest (left); at right, simulating the re-entry phase, Sweeney is experiencing a transverse force of 8.3g. This phase follows simulated separation of the third stage.



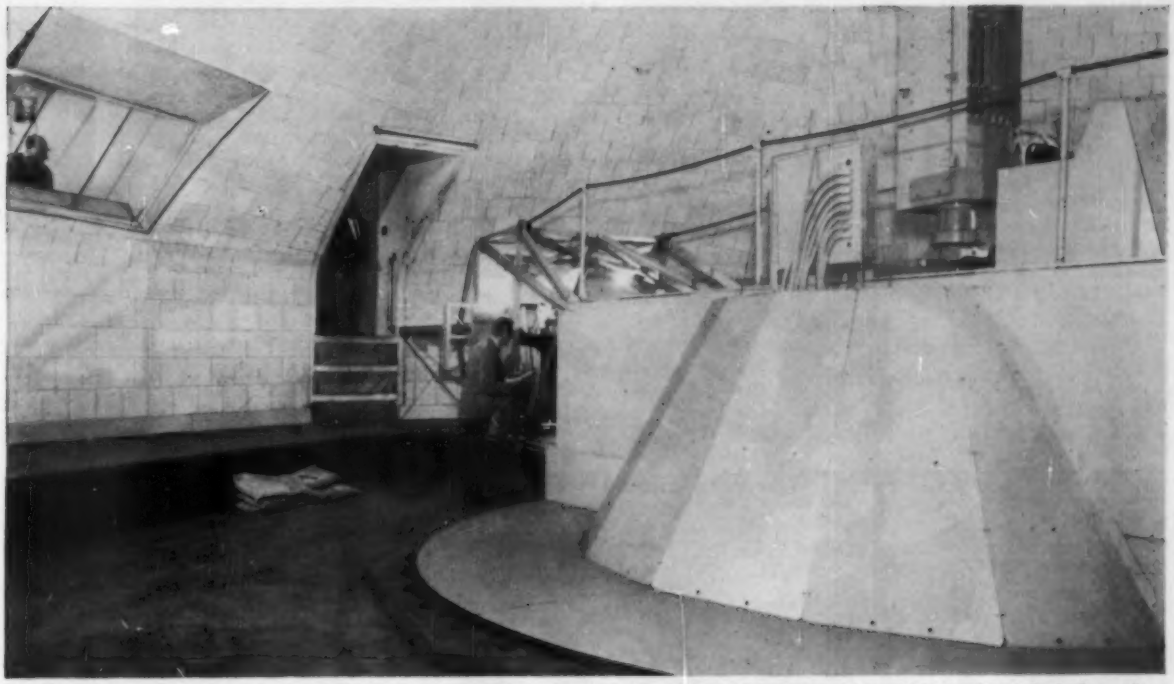
ACCELERATION history of Aviation Week pilot, compiled by University of California technicians, shows the 8.3g phase reached in re-entry (right) at about 110 sec. Launch boost phase accelerations and the time used to reach them are outlined at left.

Profile Stages

The profile was as follows:

- **First stage.** A 130 sec. buildup to a maximum transverse acceleration of 6.5g. After burnout, there was a 20 sec. rest period with no acceleration, simulated by stopping the centrifuge.
- **Second stage** spanned approximately 160 sec., with a buildup to a maximum of 4.5g. This in turn was followed by a 10 sec. rest period, simulating the time between second stage burnout and third stage ignition.
- **Third stage** would be a 110 sec. buildup to a maximum force of slightly over 2g. In the centrifuge, however, a gradual buildup to 2g, a light force, could not be simulated accurately. In actual fact, the centrifuge was started and run almost the entire time span at a level of approximately 2.3g over the entire third stage time period.
- **Re-entry phase** of the profile, which followed very shortly on the third boost phase, a matter of 15 to 20 sec. afterwards, saw a buildup to a maximum force of 8.25 or 8.3 transverse gravity force over a time span of 165 sec. The actual flight profile would have the point of maximum accelerations occurring about two-thirds of the way through the time span, at about 110 sec., with an almost symmetrical curve representing the buildup to maximum, then the decay.

The prime requisite for a pilot to operate adequately under transverse accelerations is experience. This was more



CENTRIFUGE control room is at upper left. Pilot's seat and control section is at the left center; this unit is constructed of plywood on a metal mounting. Typical orbital profile lasts 430 sec., of which 30 sec. is spent at rest to simulate burnout.

PILOT tasks are set up on the control box at forward section of centrifuge cabin area (left). Closeup of console at right shows problem box at top with button response box at bottom. Three lights on the top box indicate computation the pilot must make.

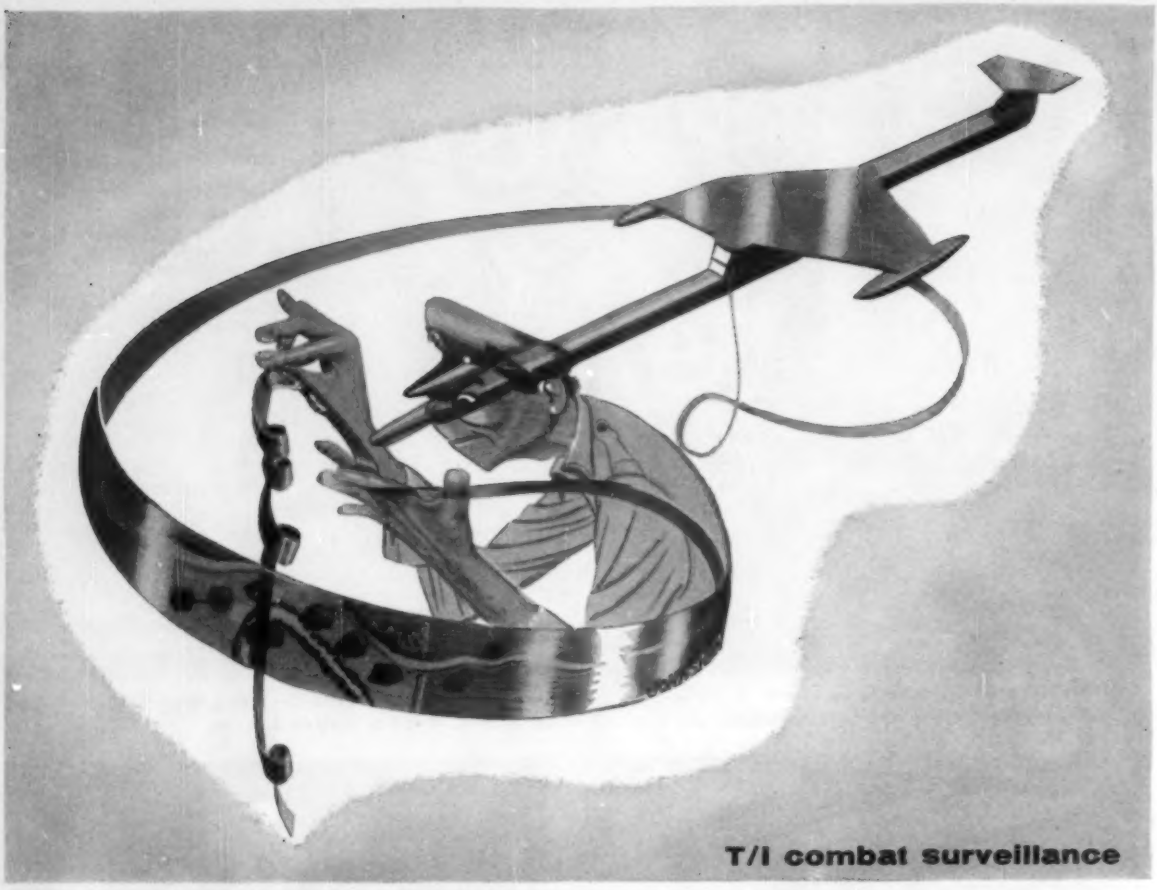
than adequately evidenced to this pilot during the orbital profile.

While taking part in the investigation prior to the orbital profile, subjects had been assigned certain tasks to be performed while under the two values of transverse acceleration.

In executing these, a small console was used by the pilot. This console, which rested on the pilot's knees, was mounted on a wood board, and had no special hand grips. It consisted of two rows of buttons mounted on an aluminum box about 1½ in. high, about 12 in. long and 5 in. wide. During the first two launch stages of the orbital profile, this pilot kept his hands on the console used in the earlier experiments, although there were no tasks assigned during the profile.

During the first boost stage of the trajectory, this pilot kept his hands in position on the console. Additionally, he was keeping his feet in place on the slanted board footrest which had been used during the earlier experiments. Here, keeping the arms and legs in place seemed to induce a stress which was not present or went unnoticed in the earlier runs, quite probably due to the fact that this time there was no task or duty for the pilot to perform.

Time period of the buildup to max-



T/I combat surveillance

Stay 'home' and see more

Aggressor terrain and positions are open secrets to TI-equipped recon drones and snooper aircraft. Field commanders can now reconnoiter "in person" far behind aggressor lines *without leaving field HQ.* Instant, accurate, continuous data on thousands of sq mi of hidden territory can flow into headquarters *in the time one foot patrol could complete its mission.* Hundreds of targets can be spotted, evaluated and brought under fire in the same time interval . . . most of them within seconds after detection.

This capability exists now at Texas Instruments. For detailed discussion, military and industrial personnel with need to know please write or call: SERVICE ENGINEERING DEPARTMENT.

RESEARCH/DESIGN/DEVELOPMENT/MANUFACTURING of systems for: *Air traffic control • Airborne early warning • Antimissile • Antisubmarine warfare • Attack control • Countermeasures • Missile systems Navigation • Reconnaissance • Space electronics; and on detector cells, engine instruments, infrared, intercom, microwave, optics, radar, sonar, telemetry, time standards, timers, transformers and other precision devices.*

APPARATUS DIVISION

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE
DALLAS 9, TEXAS

imum acceleration, and the deceleration, which simulated the first stage of an orbital flight, seemed fairly long to this pilot. Primarily, this is attributed to lack of a useful task. Also tending to induce the feeling of an extended time period was the effort required to keep the hands and feet in the proper place without support.

During first stage buildup, although the maximum transverse forces were not as high as later encountered, the over-all stress level on the pilot was considerably higher than had been experienced in the previous runs.

Optimized Seat

Had this profile been run in a reasonably optimized seat; that is, one that had provision for foot and arm restraint and/or cushioning, it is felt that the over-all stress would have been considerably lessened.

At the same time it appeared obvious that having a task of some kind to perform would additionally lessen over-all stress induced by the accelerations.

Combining a useful task with optimized environment; i.e., a properly fitted contour seat, and pressure breathing equipment, would serve to almost completely nullify the effects of the accelerations per se.

Following the first-stage buildup, thrust simulation was abruptly ended as would occur at burnout of the first-stage rocket.

The second stage buildup covered a time period of 160 sec. with peak acceleration of 4.5g.

This second stage proved considerably easier to endure than the first, primarily because experience had been gained with this type of run during the first stage test. Secondary cause of lower stress was the lower acceleration peak.

In this second-stage simulation, the arms were still extended to the console on the pilot's knees, but a better grip had been taken on the console. Feet were still held on the footboard ahead.

During this second stage, another learning advantage was that the pilot posed a certain degree of mental and physical activity for himself by reviewing the various opeartions which had been performed during the investigation conducted prior to the orbital simulation. In this, certain buttons on the control console were pushed, giving simulated answers to mentally posed problems. Although there was no reading or reaction in the control center of the centrifuge from these operations, they could be monitored by the pilot himself and rechecked for accuracy.

The conclusion reached during the accelerations experienced in the University of Southern California investigation, conducted by Richard Kaehler, that there was no obvious decrease in pilot mental facility due to the transverse accelerations, was reinforced by an exercise in rechecking computations performed during this stage of simulation.

Third-stage simulation actually consisted of 2g over a 110 sec. time period. Although the profile itself actually called for a buildup to a peak value of 2g, the centrifuge drive system is such that the 2g velocity was reached immediately.

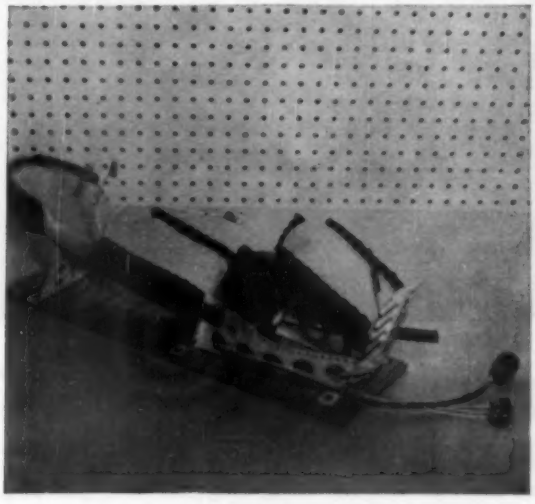
During this run, advantage was taken of the low force to reposition the arms and feet. The hands were locked over the lap belt, fingers interlaced, while the elbows were rested on the vertical edge of the seat behind the pilot. The pilot hooked his feet under the footboard instead of resting them on top.

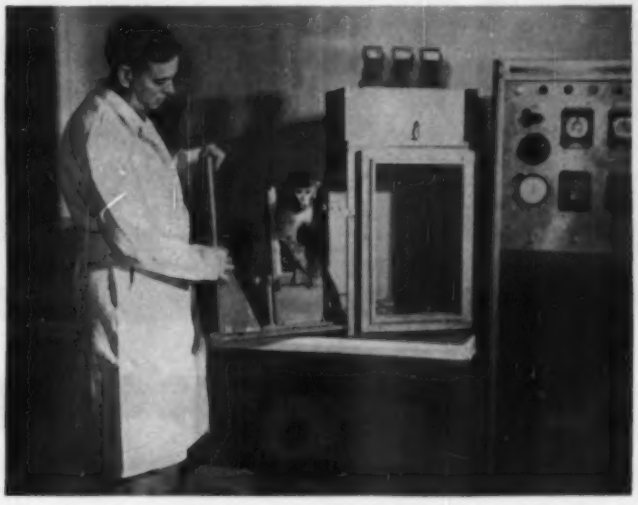
Dual Support

The positioning of the arms and elbows was such that a dual support was provided; that is, the locked fingers over the abdomen, plus a slight supporting at the elbow joint. This elbow joint placement was such that should the higher accelerations expected during reentry begin to prove painful to the elbow joint, tightening of the arm and hand muscles could relieve the pressure points on the elbow joints, thus allowing the elbows to be rotated slightly outward, leaving the acceleration forces to be entirely absorbed by the locked hands.

Techniques involved during launch stages to deal with the effects of the transverse accelerations served to considerably ease the stress during the reentry simulation.

As anticipated, arm and foot place-





USAF Develops Seat for Space Capsule Primates

Aviation School of Medicine has developed a seat (left) designed to carry primates in space capsules for such programs as Project Discoverer. The seat will carry a 4-6 lb. monkey in a Bio-Pac with a 100 lb. payload, which includes instrumentation, the monkey and capsule hardware. Each couch is individually tailored to the monkey it will carry. The seat has a glass fiber shell and is lined with foam rubber; monkey is restrained in the seat by a cloth jacket that covers the open front. Wires shown here are for instrumentation. At right, "Miss Patience," a 4 lb. monkey, one of a primate group undergoing research experiments at the School of Aviation Medicine, Randolph AFB, Texas, is placed in a basic psychomotor training unit. The monkey will be trained to perform such tasks as pulling the lever on the right wall of the box, in response to a given stimulus. Air Force says all experiments are conducted under American Medical Assn. rules for humane treatment of animals. Monkeys destined for use in space capsules must be trained in a relatively short time span.

Westinghouse equipment drives

How do you move a 30-ton building at a uniform speed regardless of 60 mile an hour winds that might push with or against it? Westinghouse engineers solved this problem when they designed the automatic shelter drive system for the Douglas/USAF THOR IRBM.

Here is the installation—a fool-proof, self-controlled drive system. The operator pushes the forward or reverse button—the system does the rest, quickly—surely. Westinghouse React-O-Verse control automatically compensates for wind pressures to determine the instantaneous power requirement to move the huge shelter smoothly and uniformly, regardless of wind direction or force.

This is additional proof of the results you obtain when you use Westinghouse range of products, engineering knowledge, single-source responsibility and ability to supply a packaged, guaranteed unit.

Take advantage of these Westinghouse facilities when designing and building retractable shelters, hardened missile sites, erectors, lowering devices or launchers. Contact your local Westinghouse sales engineer or write: Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

An illustration of a hardened missile site, suitable for framing, will be sent you if requested on your letterhead.

J-92030

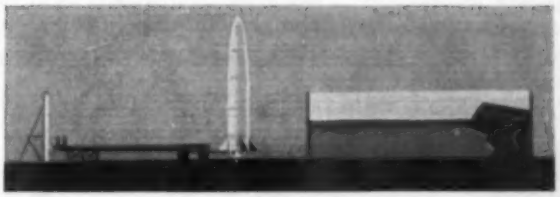
THOR retractable shelters

The Westinghouse equipment includes: 75-hp crane and hoist motor; d-c magnetic brake; double reduction gear and fly-wheel unit; React-O-Verse control; pilot generator; manual and automatic switch and controls; and floodlighting.

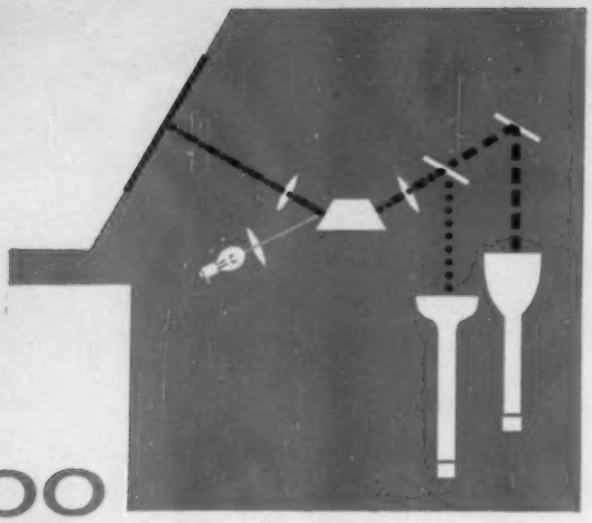
YOU CAN BE SURE...IF IT'S

Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS



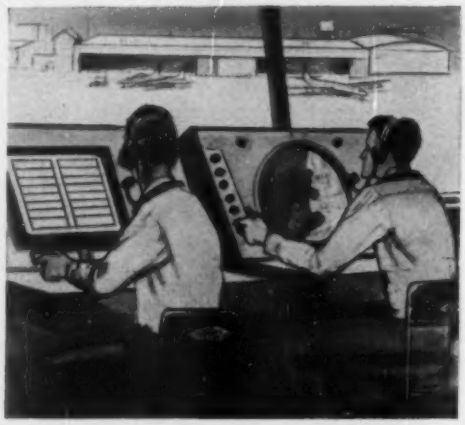
Typical THOR installation, showing a breakaway view of the drive unit in the retractable shelter, missile, free standing end wall of shelter and missile erector.

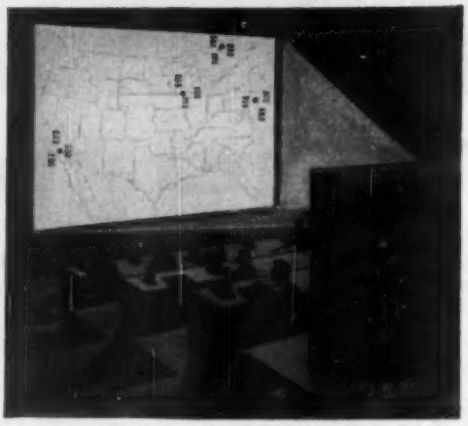


S-C 2000

BRIGHT DISPLAYS FOR CONSOLE OR LARGE SCREEN PROJECTION

Bright, fail-safe, flicker-free display of alpha-numeric, symbolic and graphic data at high speed . . . simultaneously with PPI-type radar presentations . . . is now provided by S-C 2000 Bright Displays. Displayed data may be viewed in normal ambient light directly on the screen of the S-C 2000 console, or may be projected for group viewing on a large theatre-type screen. For air traffic control and military applications, maps may be displayed concurrently with radar targets and their identifying symbols, assisting the operator in geographic orientation. The fail-safe feature of S-C 2000 Bright Displays results from use of the xerographic process which allows the last frame displayed to be retained permanently, even in event of complete power failure. Send for more complete information concerning S-C 2000 Bright Displays. Ask for Bulletin 6-W. Write today: Stromberg-Carlson — San Diego, 1895 Hancock Street, San Diego 12, California.





GENERAL DYNAMICS
STROMBERG-CARLSON DIVISION

ment eliminated the stresses encountered in this area during first stage. However, one effect appeared during this run which had not been felt before —an effort was required for proper breathing. The 6g values reached during the early runs of the day, and the simulated first stage run, posed no problem for breathing. However, during simulated re-entry after an acceleration force approximating 7½g was reached, breathing adequately required the proper technique.

Breathing Procedure

Previous breathing procedure had been to start the run with deep breathing, retain a considerable volume of air within the lungs, continue to breathe steadily and as deeply as possible through the run. The same procedure was followed to start the re-entry run, but past 7.5g the effort necessary to inhale properly and continuously increased to an extent, although it at no time reached the point where the pilot felt overstressed or in any kind of trouble.

The technique evolved to overcome the problem was to tense the diaphragm and chest muscles in so far as possible, and breath as steadily as reasonable with as much force as possible, rather than take the short gasping breaths which would have been a natural tendency.

Following the procedure of deliberately trying to breathe as deeply as possible on a steady inspiration and expiration basis, proved adequate for the acceleration forces encountered throughout this regime.

Accelerations in the re-entry phase were front to back, the same plane as the other three stages. This was because the flight envisioned a vehicle which would have a re-entry attitude similar to that of the Project Mercury capsule; that is, it would decelerate with the pilot facing backward.

Battelle to Study Space Oxygen System

Research leading toward development of a system to free oxygen from carbon dioxide, eliminating a hazard in future space flights, has been started by Battelle Memorial Institute scientists at Wright Air Development Center's Aero Medical Laboratory.

Three possible ways to recycle a limited oxygen supply were outlined by Dr. John F. Foster, director of research. They are:

- **Use of extreme heat** to free oxygen from carbon dioxide.
- **Reversing basic processes** of human metabolism by a chemical reduction.
- **Photosynthesis,** "nature's own method."

System design specifications call for a capability of processing carbon dioxide at a rate which will provide oxygen for one or two men from a month to three years. The system also must operate efficiency at an atmosphere one-third as dense as the earth's, at sea level.

In addition, the proposed system must be independent of the force of gravity, must operate on a minimum of electrical power or heat energy and must be as light and compact as possible to operate with a minimum of maintenance.

At present, Dr. Foster said, the system of chemical reduction "seems, at this time, to most nearly meet Air Force requirements." He said the system involves a reducing agent to convert carbon dioxide into solid carbon; as a follow-up, the oxygen would be recovered as a gas.

The scientist added that photosynthesis—chemical process in which green plants manufacture their food supply and give off oxygen—employs long range possibilities and is "quite attractive."

Least practical, according to Dr. Foster, is the method of freeing oxygen by use of extreme heat, or thermal decomposition. He cited poor efficiency and extreme weight of necessary equipment.

Illustration For The Book Of Knowledge

Before this failed piston hits the scrap heap, an Airwork inspector makes a highly detailed photo of it. This photo becomes part of our study file of possible piston malfunctions . . . of scuffing and burning.

For example, a piston shows wear in an unusual area. Not enough to require replacement at this overhaul—but . . . what caused it?

Airwork photographs the condition . . . pulls out the photograph for accurate comparison the next time the piston goes through overhaul. We know if the original wear condition is potentially dangerous—or whether it is safe for another run.

This is one more example of how Airwork uses modern methods—backed by craftsmanship—to make sure every part returned to an engine will give satisfactory service throughout the entire operating cycle yet to come.

You are safer with an Airwork overhauled engine — because Airwork takes more time and trouble to be sure your engine is in first class condition.

Airwork CORPORATION
Millville, New Jersey

BRANCHES IN:
WASHINGTON
NEWARK • MIAMI • ATLANTA
CLEVELAND • NEW YORK

Airwork

THE NAPIER JET-PROP CANADAIR-CONVAIR 540

Napier 3500 hp. jet-prop engines will convert your Convair 340/440 into a jet-prop Canadair-Convair 540 . . . or you can buy a brand-new Napier-powered Canadair-Convair 540.

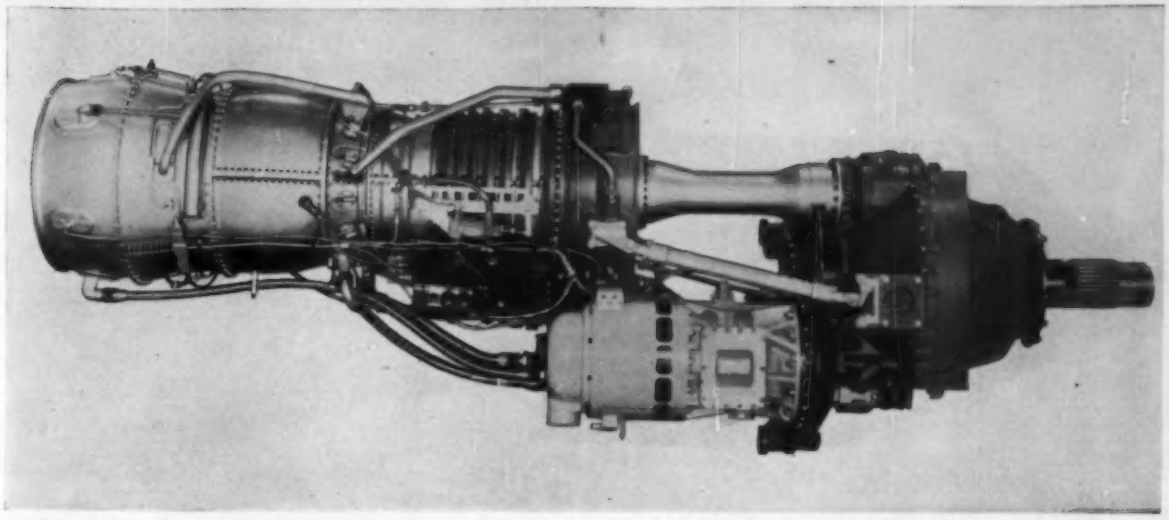
- **Terminal to terminal operation on routes up to 650 miles—multiple stops—without refueling—with full passenger load and normal reserves**
- **326 mph. guaranteed cruising speed at 20,000 feet**
- **Comfortable seating capacity optional to your requirements—up to 58 seats**
- **Increased passenger appeal—because noise and vibration are minimized**
- **56% reduction in climbing time to cruise altitude**
- **20 years of profitable service life ahead**

A world-wide demonstration flight tour is now underway. Arrange for your see-for-yourself flight by writing to Napier Engines, Inc., 909 Dupont Circle Building, Washington 6, D. C.

*58 seat configuration . . . 500 mile stage

NAPIER
ENGINES INCORPORATED

A SUBSIDIARY OF D. NAPIER & SON, LTD., LONDON, ENGLAND • A MEMBER OF THE ENGLISH ELECTRIC GROUP OF COMPANIES



TURBOPROP version of General Electric T64 engine produces 2,570 equivalent shaft horsepower and weighs 1,079 lb.

T64 Designed in Three Basic Versions

By Cecil Brownlow

Washington—General Electric is offering its lightweight T64 turbine engine to military and industry contractors in three basic versions—turboshaft, turboprop and direct drive—as a replacement for present piston installations and as the powerplant for new aircraft and helicopters now on the drawing board.

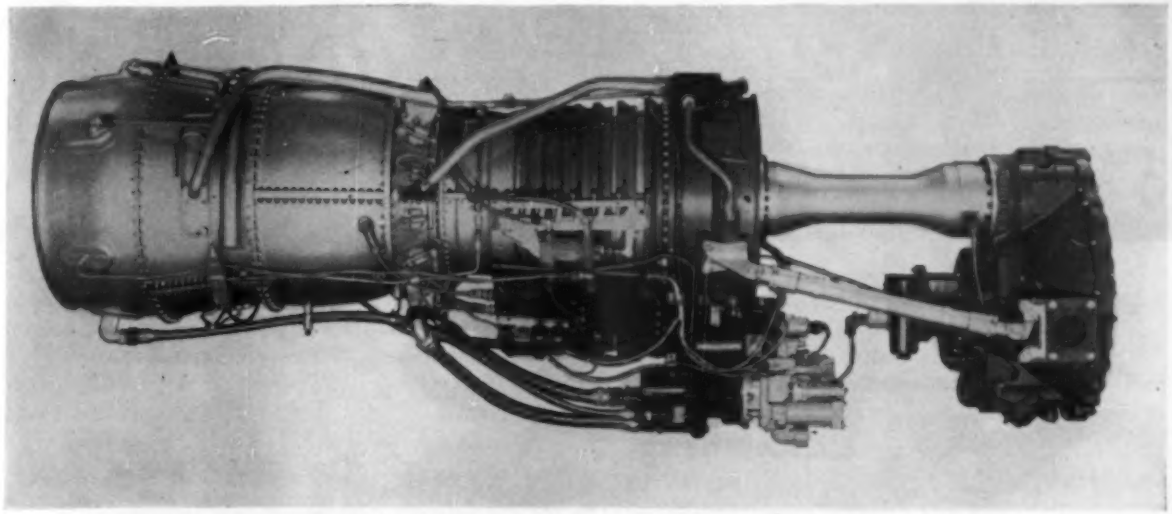
Developed by GE's Small Aircraft Engine Department, Lynn, Mass., under a $58 million Navy contract that will carry it through its 150-hr. qualification tests, the T64 was designed specifically for high-performance support and tactical aircraft. Primary goal during its design was low specific fuel consumption, with weight a secondary factor.

Turboshaft Version

The 2,570 shp. turboshaft version weighs 854 lb. and has an sfc. of 0.506; the turboprop weighs 1,079 lb., delivers 2,570 eshp. and has an equivalent specific fuel consumption of 0.522. Shaft speed is 5,200 rpm. for the T64-2 turboshaft; 1,150 rpm. for the —4 turboprop. Overall-length of the —2 is 91 in.; of the —4,113 in.

The direct-drive version of the engine, obtained by removal of the gear box, weighs 710 lb., has an shp. of 2,690 and a specific fuel consumption of .498, according to General Electric. Shaft speed is 13,600 rpm.

The six engines now running on the test stands at Lynn have accumulated a total of slightly more than 300 hr. thus far. The —4 turboprop, first tested in January, is scheduled to complete its 150 hr. qualification test by December, 1961. The —2 turboshaft made



T64 TURBOSHAFT version has essentially the same control components as the T64 turboprop; basic main reduction gear is common to both engines.

SCHULZ TOOL AND MANUFACTURING CO. has, for many years, worked closely with the various services and the aircraft industry in the design, test and manufacture of equipment related to modern aircraft fuel systems. This experience is available to assist you from design to efficient manufacturing.

SCHULZ
TOOL & MANUFACTURING CO.

425 SO. PINE ST., SAN GABRIEL, CALIF. • EASTERN REPRESENTATIVES—EAST COAST ENGINEERING SALES AND SERVICE...1405

AERIAL REFUELING TANKERS

STRATEGIC OR TACTICAL

Now, in a matter of minutes, Air Force tankers can be converted from a strategic to a tactical role.

This kit is designed for field conversions from the boom system to the probe and drogue system—successfully tested and now operational with the Air Force.

The kit containing all components, spares and test equipment is designed for stowage aboard the tanker aircraft. Thus equipped, Air Force tankers can refuel most aircraft anywhere in the world.

SCHULZ TOOL AND MANUFACTURING CO. is proud to be associated with the design, test and manufacture of this advanced aerial refueling equipment.

NORTHERN BLVD., ROSLYN, NEW YORK

PUMP PRIMERS

by
Arthur A. Nichols

"Gerotor Pumps Better Than Spur Gear Pumps?"

Yes, in most aircraft applications, Gerotor pumps are far superior to conventional spur gear pumps. This is a completely unbiased opinion because we are a leading manufacturer of both types and are committed to neither. In fact, the first pumps we made, back in 1926, were spur gear pumps. These accurate metering pumps now produce most of the rayon, acetate, celanese, nylon and other synthetic fibres spun all over the world.

But such aircraft applications as lubricating, scavenging and hydraulic systems impose far different requirements of speed, inlet conditions and mounting. These are the very conditions which Gerotor pumps are specifically designed to meet.

The superiority of Gerotor pumps for aircraft applications stems from their simple design — only two moving parts rotating in the same direction around a single shaft—and their exceptional adaptability to installation and space requirements. *(Fig. 1)*

Fig. 1.

The Gerotor pump's single shaft, with its single bearing reduces by one-half, the problems of locating, aligning and maintaining a spur gear pumps' two bearings. Tooth wear in Gerotor pumps is far less than in spur gear pumps having the same shaft speed. That's because Gerotor elements revolving in the same direction have lower relative speed. For example, in a pump with a 5-toothed outer Gerotor and a 4-toothed inner Gerotor, when the shaft is rotating at 1800 rpm, the inner and outer Gerotors are revolving at only 360 rpm in relation to each other.

Application adaptability is inherent in the Gerotor pump. By varying diameters, thicknesses and tooth sizes of Gerotor elements, a needed capacity can be built into a wide variety of housing dimensions. Multiple functions, such as lube, scavenge, boost, etc., can also be obtained by stacking Gerotor elements along a single shaft. *(Fig. 2)*

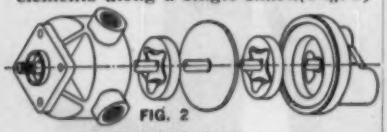
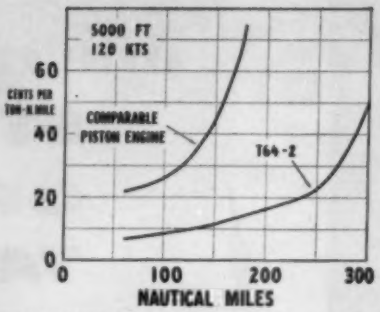
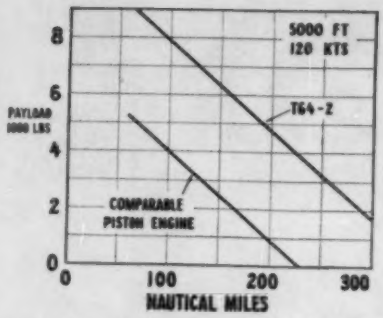


Fig. 2. Multiple function pump.

Technical data, engineering assistance and production facilities are available. Your inquiry is invited.

W. H. NICHOLS CO.
Woerd Ave., Waltham 54, Mass.





COMPARISON of fuel costs and range between a piston engine and the T64-2 turbine engine is outlined in General Electric chart (left). Payload-range comparison is at right.

its first run in March and has a target date of August, 1961, for completion of its 150-hr. qualification. Experimental flight tests are expected to begin sometime next year.

The development program as laid out by project manager Edward Woll calls for a total of approximately 10,000 hr. to have been accumulated by the time qualification testing is completed.

General Electric first made its proposal for a T64-type engine with low specific fuel consumption to Navy's Bureau of Aeronautics approximately four years ago and was built, Woll says, "in the face of the general philosophy that you don't build an engine if you don't have a specific airframe to go into it." Actual work on the engine was begun in 1957.

At present, only airframe definitely scheduled to take the T64 is the turbine-powered version of the Sikorsky S-60 flying crane (AW April 20, p. 29). Sikorsky engineers say installation of two T64s as replacement for the present 2,100 hp. Pratt & Whitney R2800 piston engines should boost the S-60's payload by as much as two and one-half tons and probably provide added range.

Projected Uses

Projects being considered by Bureau of Aeronautics for the engine include an STOL version of the Grumman S2F carrier-based anti-submarine-warfare search plane and an aircraft to fit into Navy's "slow-plane" concept as a platform for its long-range Eagle air-to-air defense missiles.

A number of airframe companies, including Boeing, Chance Vought, Convair, Fairchild, Grumman, Martin and Vertol, also are discussing the various potentials of the T64 with General Electric. These include, according to Woll, use in cargo-assault helicopters, carrier (with two T64s) and water-based (with four to eight engines) anti-submarine-warfare aircraft, VTOL and STOL transports and airborne early warning planes.

As a possible powerplant for VTOL tilt-wing applications, the T64 was designed with a built-in capability of operating continuously at an attitude 100 deg. above the horizontal. It also can be operated 45 deg. below the horizontal for use by helicopters performing air-to-ground and air-to-water towing missions.

In addition to its incorporation into new designs, project manager Woll believes that the low specific fuel consumption, the relatively lower cost of turbine fuels and the light weight of the engine may make it economically feasible for the Navy or other services to replace present piston installations with the T64 on a number of existing aircraft.

Essentially, both the turboshaft and turboprop versions of the engine employ the same control components. The basic main reduction gear common to both models is offset and accessible for inspection, removal or replacement.

The T64-2 turboshaft is completed by the addition of a reduction gear box cover plate and an internally-splined output shaft to the basic reduction gear.

Engine Design

The T64-4 turboprop version is formed by the addition to the basic main reduction gear of a planetary reduction gear and propeller brake.

Other details of the turboprop engine include:

• **Compressor** is a 14-stage axial-flow type. It has a smooth single spool steel rotor with the first two stages shrouded. Blades can be removed individually

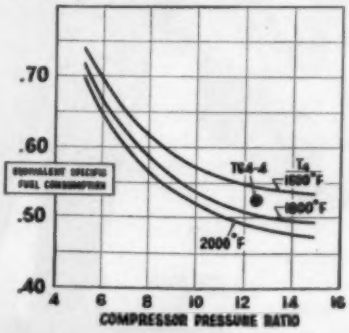


CHART shows equivalent specific fuel consumption versus compressor pressure ratio.

ROCKET ENGINES

NEW tungsten linings for rocket nozzles...

MELTING POINT: 6170°F.

Tungsten-lined lightweight nozzles for solid propellant engines are now being fabricated by General Electric. With a lining melting point of 6170°F, these are among the highest temperature lightweight fixed and flexible nozzles in use in the missile industry, enduring high rocket propellant temperatures and pressures with no measurable erosion.

These nozzles are produced by an arc-spraying process pioneered by General Electric. Tungsten is vaporized in an arc and deposited on a mandrel. For some applications, the liner is molded in lightweight plastic, and the mandrel leached out.

Arc-sprayed nozzles have been hot-fired with the new high temperature propellants at several locations.

G.E.'s capabilities in metallurgy and manufacturing are combined with equally advanced capabilities in engineering, research and development. Integrated advanced rocket engine capabilities at General Electric can meet your needs for high performance solid propellant engine cases, nozzles and liquid engine components using cryogenic and storeable propellants.

Progress Is Our Most Important Product

GENERAL ELECTRIC

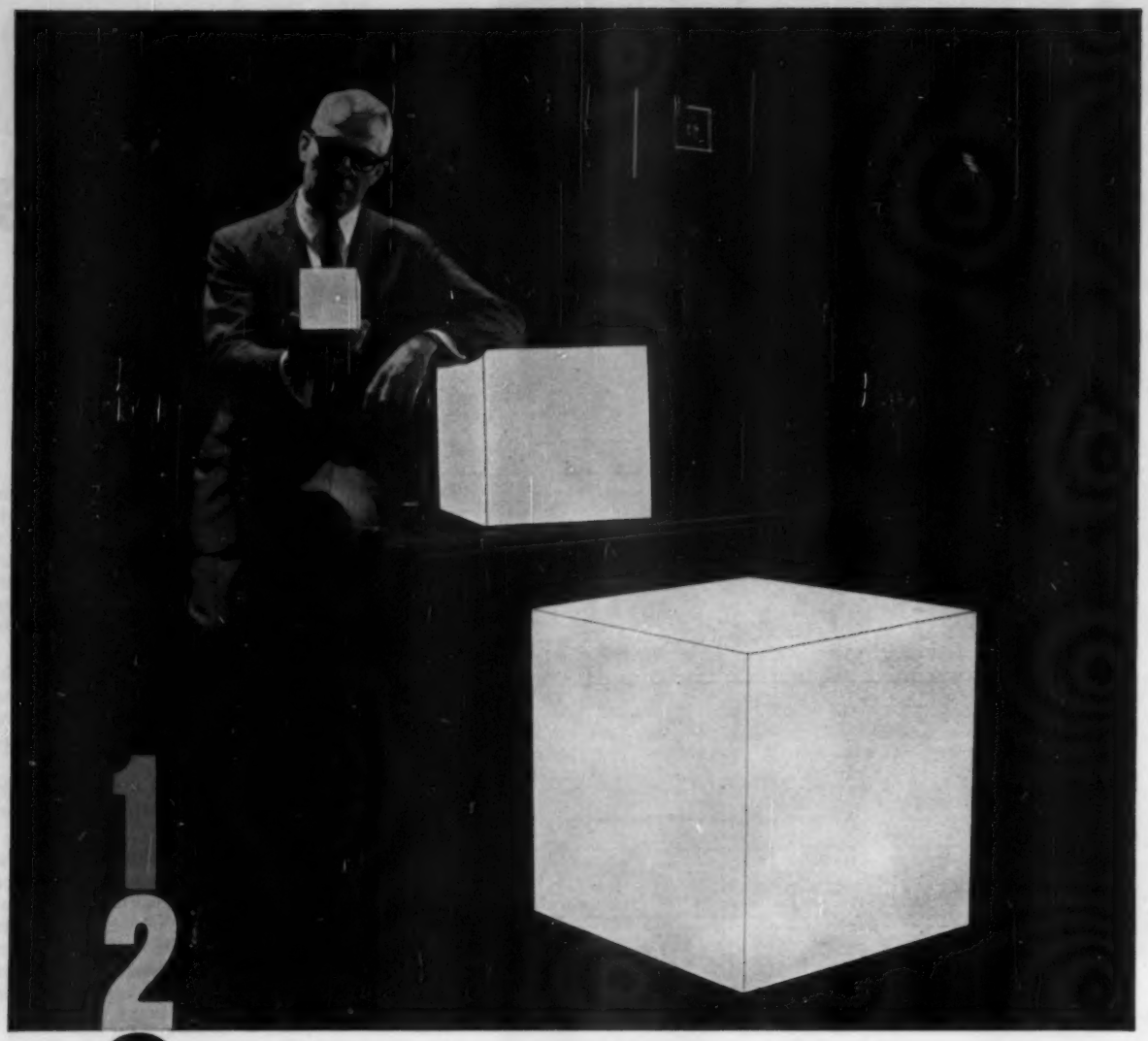
The Flight Propulsion Laboratory Department's Rocket Engine Section is the nucleus of General Electric progress in rocket engines and their components. It is well-equipped; and it uses Company-wide capabilities and experience to speed advances. If you would like more information about the section's products and capabilities in solid or liquid propulsion systems, please mail this coupon. Rocket Engine Section, General Electric Co., Cincinnati 15, Ohio.

Section B182-2
Rocket Engine Section
Flight Propulsion Laboratory Department
General Electric Company
Cincinnati 15, Ohio

Please send me additional information about General Electric solid propellant cases and nozzles (GED-3763). ☐

I would like to discuss G-E rocket engine products with a sales representative. ☐

Name.....
Title.....
Company.....
Address.....
City.....**State**.....



3 generations of airborne digital computers (but we can't show you their configurations)

In the photo above, the three ARMA computers have been intentionally deleted. But the cut-outs accurately represent the relative size of the three generations of ARMA airborne digital computers.

The larger size has been *in production* since 1957. The middle-sized one (a quarter the size of today's) will be in production in 1960. And the micro-miniaturized version in the engineer's hand will be operational in 1962—only .3 cubic feet in volume.

A production line unit of ARMA's current model has operated in excess of 4000 hours without a component replacement. And the 1960 and 1962 versions will have reliability factors at least equal to this.

With this program of miniaturization, ARMA has made the digital computer truly airborne. ARMA . . . Garden City, New York. A division of American Bosch Arma Corporation.

6939

AMERICAN BOSCH ARMA CORPORATION

T2J Jet Trainer Completes Carrier Tests

North American T2J jet trainer, landing hook secured for a "touch-and-go" carrier landing, makes final approach over the stern over the USS Antietam, first of Navy's canted deck carriers. Carrier suitability tests were made by three T2Js and were completed successfully after about 50 catapulted takeoffs and arrested landings, plus another 50 touch-and-goes. Fleet Introduction Program at Patuxent River, Md., is nearly completed.

without rotor disassembly. The inlet guide vanes and first six stages are variable. The stator, a steel unit split and flanged along the horizontal centerline, has removable stator vanes.

• **Combustor** has a straight-through full annular liner split for accessibility and replacement. A single fuel manifold feeds 12 duplex-type fuel nozzles with integral flow dividers. The nozzles are mounted on the compressor rear frame outer diffuser wall.

• **Gas generator turbine** is a two-stage, axial-flow type coupled directly to the compressor rotor by a spline connection. A low-pressure air impingement starter manifold is located on the turbine casing. Provision also has been made for mechanical starting.

• **Power turbine** is mechanically independent of the gas generator turbine.

T64 Maintenance

Another feature which Woll and General Electric hope will boost the T64's chances for a long and profitable life is the maintainability built into the engine during its design. Maintenance features include:

• **Main reduction gearing** is separable as a unit from the basic engine for servicing and inspection.

• **All blades, vanes,** assemblies and buckets can be inspected, removed and replaced individually without disassembly of the engine except for the removal of the flanged compressor or turbine casing.

• **Combustor liner** can be taken apart for accessibility and to permit inspection and replacement without complete disassembly of the engine.

• **Nozzles and ignitors** are accessible without engine disassembly.

• **Second, third and** fourth stage diaphragms can be inspected and replaced without complete disassembly of the engine.

• **All fluid lines** are located at the bottom of the engine.

• **All accessories** have been placed in one area to facilitate servicing.

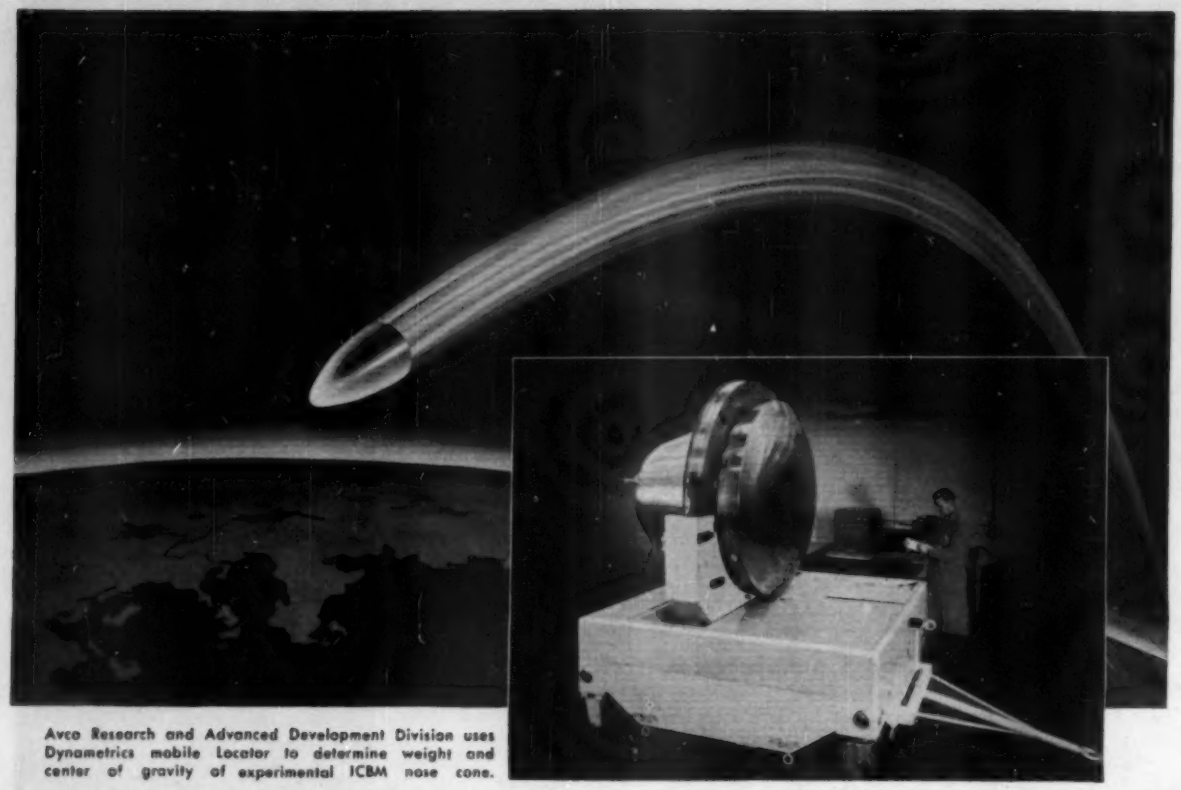
Weather Sensor Tested in 707

Airborne weather-sensing system developed by Bendix Aviation Corp. has completed initial flight testing aboard a Boeing 707 jet transport operating out of Yakima, Wash.

The system gives forecasters a three-dimensional view of a "weather picture" transmitted from the aircraft (AW Oct. 6, 1958, p. 80).

Radiosondes were ejected at high velocities at intervals of several hundred miles, Bendix engineers said. Ground test firing of the rocketsondes will be conducted soon at Holloman AFB, N. M.

QUICK CHECK
protects against in-flight engine failure
LISLE
CHIP DETECTORS
A powerful Alnico magnet in the Lisle Chip Detector attracts any ferrous metal particles present in the lubricant. These particles bridge an electrically insulated gap and complete an electrical circuit for a positive reading on a continuity tester.
This quick, positive check provides an advance warning of possible internal breakdowns before in-flight failure.
A continuous in-flight warning system can be provided by wiring the Chip Detector to the pilot's or flight engineer's panel.
• WRITE for Free Catalog and Samples for testing
LISLE
CORPORATION
Clarinda, Iowa



Avco Research and Advanced Development Division uses Dynametrics mobile Locator to determine weight and center of gravity of experimental ICBM nose cone.

PUTTING THE BUSINESS END . . . IN BUSINESS

The nose cone or "business end" of an ICBM will disintegrate from the violent shock and 15,000°F temperature that builds up as it plunges back into the dense air surrounding the earth's surface, unless re-entry can be made at the optimum attitude.

Dynametrics has developed a Weight and Center of Gravity Locator for precise determination of weight of the nose cone and CG components along its 3 principal axes as part of the procedure for insuring that the nose cone will be aligned properly as it re-enters the atmosphere. Avco Research and Advanced Development Division, developers of re-entry vehicles for the Air Force Titan and Minuteman ICBM's, are successfully using a Dynametrics Locator to put the "business end" in business.

The Dynametrics Weight and Center of Gravity Locator combines the accuracy of a laboratory static balance indicator with the ruggedness required for field usage. At the flip of a switch, this unique instrument gives easily legible digital readout of weight and center of gravity for two axes of the nose cone. Then, by rotating the cone 90°, another reading is obtained in the same manner along the third axis. Measurements are independent of gravity variations since the instrument operates on the principle of gravity moment balance rather than spring deflection.

Capacity of the Locator is more than 4,000 lbs. with an indicator resolution of tenths of pounds. The Locator is mobile by air transport and is adaptable to quick field setup. This instrument can be used by untrained personnel — a most significant feature with reference to the operational phase of missile work.

The Weight and Center of Gravity Locator is a typical example of Dynametrics' capabilities in solving difficult force and pressure measurement problems. Write for technical information about any one of the Dynametrics' three areas of interest: *Special Services and Equipment* such as Wind Tunnel design, CG Locators, Strain Gage Balances, and Missile and Aircraft Models: *Weighing, Proportioning, and Batching Systems; Pressure Measuring Instruments* such as Manometers, Primary Presure Standards, Digital Barometers, etc.

DYNAMETRICS CORPORATION
Northwest Industrial Park • Dept. 16 • Burlington, Mass.

Centrifuge Furthers X-15 Pilot Safety

Los Angeles—Details on findings gathered during three centrifuge programs run on the North American X-15 rocket research vehicle, including aspects of acceleration and control paramcters, were presented here recently.

Centrifuge programs were run at Aviation Medical Accelerations Laboratory, Naval Air Development Center, Johnsville, Pa. Instrumentation package was developed at North American Aviation, designer of the X-15. Both presentations were made during the Acromedical Assn. meeting here.

Information on a physiological instrumentation package which was designed for the X-15 program also was given.

Response Patterns

Seeing the requirement for collecting data on the response patterns of pilots undergoing tension and stresses is similar to those which would be encountered in space flight, the Acromedical Laboratory at Wright Air Development Center authorized development of a package with this capability in 1958, which could be used in the X-15 research aircraft, according to W. V. Blockley, of North American Aviation, Inc.

The system provides for recording on board the airplane by means of conventional photographic oscillographs, nine channels of physiological information, plus two channels of pressure information relating to protective functioning of the full-pressure suit. These two channels are intended to be telemetered to the ground by the aircraft's basic telemetry system.

All of the 11 channels operate siumultaneously.

The package includes four differential electrocardiograph amplifiers, four thermistor bridge circuits for temperature measurement, bridge circuit with temperature compensation for a heated thermistor type pneumotachometer and two pressure transducer bridges. Power supply is included. The delivered equipment also has leads to the pilot with a novel design of light weight electrocardiogram electrode, a new means of electrode detachment, three disk type skin thermistor pickups and a sealed rectal themistor probe.

Also, included are two miniature strain gage transducers with housing for installation in the pressure suit; a pneumotachometer flow meter for installation in the oxygen breathing system; zero and calibrate circuits compatible with the aircraft system, as well as provisions for manual actuation; artificial signal generator for preflight checkout of the system without a human pilot; and connector pads with snap fastener components for conducting the full-pressure suit to the amplifiers.

The four electrocardiograph differential amplifiers utilize transistors and printed circuitry, and performance characteristics comply with the requirements of VA Specification 3145275A for direct writing electrocardiographs. Empty space has been left in the design, and plug-in provisions and housing are relatively massive and rugged. This was done in the interest of reliability, freedom from and ease of maintenance, and using the relatively liberal space allowed in the X-15 bay for installation of the package.

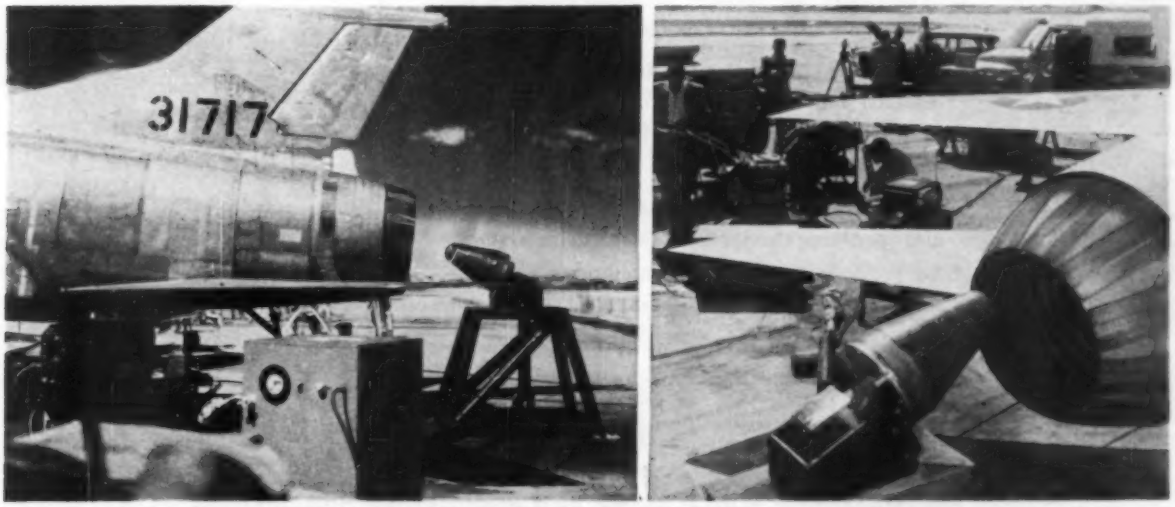
Further miniaturization will be easy when extensive in-flight service has confirmed the circuitry.

Electrode Design

Electrode design was such as to meet the comfort requirements under the tight fitting full pressure suit for long periods. Disk of flexible Monel metal mesh has a stub lead molded to it with insulated portion secured to the rim for strain relief. The leads are connected to the suit at a suitable connector pad.

Electrode placement on the pilot represents a compromise between the desire for the classical limb leads and the requirement to minimize muscle potential noise. Compromise was worked out to minimize noise pickup in the system, yet remain as close as possible to the conventional electrocardiograph data.

Three skin temperature pickups are used with bridge circuits designed to accommodate a temperature range from 80 to 120F. Thermistor rectal probe



"Q" BALL, re-entry attitude sensor for the North American X-15 research vehicle, has completed National Aeronautics and Space Administration qualifications at Edwards AFB, Calif. (AW Dec. 15, p. 59). Temperature and pressure expected duriag the re-entry phase of flight was produced by mounting the "Q" ball on a steel framework in the exhaust wake of an F-100 jet fighter. Aircraft was tethered at NASA's thrust calibration stand so that engine could be operated in full afterburner. Two runs, first of 5 sec. and then a 7 sec. run, were conducted with the "Q" ball at 24 deg. to the horizontal, considered to be the maximum nose-up attitude during re-entry. Developed by Nortronics Division of Northrop Corp., "Q" ball made of Inconel X, is internally cooled by liquid nitrogen. The device will be mounted on the nose of the X-15. Velocity of the exhaust wake was approximately Mach 1.1; flame temperature was 3,700F. Nortronics engineers say that "Q" ball withstood skin temperatures of about 2,000F and pressure of 2,000 psi.

Moment of Decision

(Continued from Inside Back Cover)

The observer was standing up with his arms folded and his empty ammunition belt flapping over the edge of the cockpit. Could the American shoot down an unarmed enemy? He hesitated. Then, in a moment of decision, he maneuvered again and started firing. In that moment, Lt. Douglas Campbell became an American ace of World War I. The German Rumpler was his fifth officially confirmed air victory.

At 22, Doug Campbell of San Jose, Calif. was flying in 94 Squadron—the famed "Hat-in-the-Ring" squadron that was destined to score a record of 69 enemy kills. A graduate of Hotchkiss and Harvard, Campbell was sent to Paris as a cadet in August, 1917.

Since there were no trainers available for beginners, Campbell entered an advanced flying class. He learned to fly in a fast scout—a Nieuport 23. From the model 23 Campbell progressed to the Nieuport 28.

Campbell and his fellow Americans found the 28 simple to fly. Although it suffered strong gyroscopic effects from the rotary engine, the 28's maneuverability and rate of roll were outstanding. The plane tended to spin easily, but recovery was quick. There were only two valid complaints against the 28: its susceptibility to fire, caused by accumulation of gas in the cowling unless fuel was cut off from non-firing cylinders, and its wing fabric shedding

EXACTLY WHAT IS A "SUB"?

We doubt that anyone has yet accurately described the role of the sub-system contractor. We therefore submit the following: The sub-system contractor

- Directly supports the system manager and the system prime contractor;
- Supplies subordinate systems that contribute to the overall utility and reliability of the entire system project;
- Offers broad capabilities and depth of experience in electronic and electromechanical research, design, engineering and manufacturing;
- Contributes consistently to such important research and weapons system programs as Atlas, Thor, Jupiter, Bomarc, Titan, Polaris, F-104, F-106 and others; and
- Demonstrates capabilities in management, finance and operations that are based on a full understanding of the requirements for the producibility and reliability of the entire system project.

We hope system managers and prime contractors accept this definition as the basis for selecting "subs."

We'd welcome the extra business.

For electronic sub-systems and electro-mechanical components to meet the requirements of the space age...

ELECTRONIC SUB-SYSTEMS Instrumentation Sub-Systems • Inverters and Converters • Ground Support Equipment • Power Conversion Equipment • Control and Distribution Equipment • Automatic Production, Inspection and Test Equipment

ELECTRO-MECHANICAL COMPONENTS Relays • Contactors • Static Switching Devices • Logic Devices • Malfunction Sensors • Malfunction Controls • Timers • Programmers • Tape Recorders • Accessory Electronics • Recording Accelerometers

in high speed dives. But properly handled, the 28 was a safe and superb fighter.

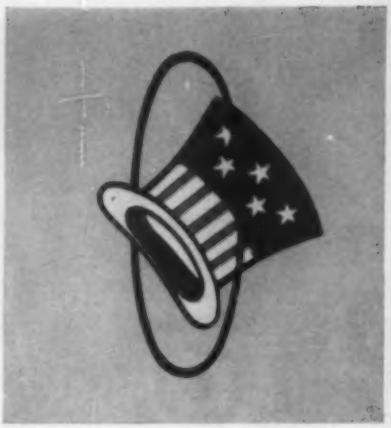
On April 14, 1918, 94 Squadron received the first war flight order given to a squadron completely manned by American pilots. It marked the maiden flight over enemy lines for Eddie Rickenbacker. But credit for shooting down the first German plane that day — the first such kill by a member of the A.E.F.— went to Doug Campbell. In the next six weeks he scored three more victories.

Then on May 31, Campbell went out alone looking for trouble. He spotted the two-seater Rumpler. Its destruction made him an ace. Five days later he encountered another Rumpler, his sixth and last victim. In the final seconds of the air battle, an explosive bullet fired by the German observer exploded inches from Campbell's back.

Doug Campbell never fought again. He returned to duty in November, 1918, only to find that the fighting days of his old squadron were over.

Heritage of the Air

One of the most inspiring chapters in the history of flight is the story of the men and flying machines of World War I. It is a highly personalized story of brave men—and the wood, wire and linen that converted manpower to airpower. Because it shares the many fine traditions of aviation, Leach is proud to present this Heritage of the Air Series.



94 SQUADRON...*more aces, more victories than any other American squadron.*

FROM THE HELMET-AND-GOGGLES ERA *to the space age, Leach has served the industry of flight with components of unsurpassed reliability...with power conversion and instrumentation sub-systems...and with unique technical capabilities.*

Solving problems is the core of the Leach philosophy of doing business. For more than a quarter of a century, Leach has steadily built a tradition of anticipating customer needs—and meeting them with advancements based on specific requirements.

This is why Leach components and sub-systems can be found in the vast majority of today's operational aircraft and in most major missile projects. This is why Leach is uniquely equipped to meet the varied challenges imposed by the new and constantly evolving concepts of today's weapons and communications systems.

Ground support sub-systems, such as this low-silhouette power supply unit wheeled under the wing of a DC-8, are custom designed, engineered, and manufactured by Leach's Inet Division.

LOOK TO LEACH

LEACH CORPORATION

18435 SUSANA ROAD, COMPTON, CALIFORNIA

DISTRICT OFFICES AND FIELD REPRESENTATIVES IN PRINCIPAL CITIES OF U.S. AND CANADA EXPORT: LEACH CORPORATION, INTERNATIONAL DIVISION

NEW LOW-NULL MOTOR GENERATORS

HOLD DOWN OUTPUT NULL TO 0.003 AND 0.006 V.

Daystrom Transicoil has whittled the null output voltages of its Size 9 and 11 Motor Generators down to a slim 0.003 and 0.006 respectively. Signal to noise ratio gets a big boost up to 120:1 for Size 9 and 100:1 for Size 11. Linearity is within .25%. A wide range of gear ratios can be furnished.

Complete specifications with drawings and charts are yours for the asking. Other types and sizes of motor and motor generators are also available. And be sure to get complete details on our new synchro line. Daystrom Transicoil, Division of Daystrom, Inc., Worcester, Montgomery County, Pa. Phone: JUNO 4-2421. In Canada: Daystrom, Ltd., 840 Caledonia Rd., Toronto 19, Ont. Foreign: Daystrom International Div., 100 Empire St., Newark 12, N.J.

DAYSTROM TRANSICOIL DIVISION OF DAYSTROM, INC

Representatives in Canada and Other Foreign Countries

has an individual calibration for the temperature range 94 to 105F. The indicated ranges can be altered by means of a balance adjustment in the circuit.

The pneumotachometer located in the oxygen supply line to the helmet has one heated thermistor and two reference or compensating thermistors in a bridge circuit. Degree of bridge imbalance is recorded and is directly proportional to the rate of heat loss from the warm thermistor to the oxygen stream. This heat loss is in turn proportional to the square root of mass flow rate. Producing a logarithmic record, data must be converted to linear coordinates to reproduce the familiar shape of human respiratory flow cycle. Calibration has confirmed that the response of the device is entirely adequate for reproduction as required.

Two miniature strain gage pressure transducers are used in the suit to monitor suit and helmet pressures. One is mounted in the gas retention layer of the suit, with one side exposed to ambient pressure and the other to suit pressure. The second is mounted in a pocket inside the suit with a reference for it connected by a rubber tube to a nipple which penetrates the neck seal of the suit. Thus, the latter unit indicates the differential existing between the helmet and suit. For safety of the wearer, the helmet pressure is always slightly higher than that in the suit to ensure that only pure oxygen is breathed.

Environmental Tests

Environmental tests of the complete package have included operation under the following conditions:

- **Temperatures** from −20 to +160F.
- **Altitudes** up to 83,000 ft.
- **Vibration** up to 10g at frequencies from 10 to 500 cps.
- **Continuous acceleration** of 10g.

First flight demonstration of the system was accomplished in a Convair TF-102, operated by the Human Factors Branch at the Air Force Flight Test Center, Edwards AFB, Calif. Work was to familiarize pilots with characteristics of the XMC-2 full pressure suit.

It is contemplated that additional parameters can be measured by the package in future versions. Those favored for early inclusion:

- **Automatic blood pressure** recording.
- **Photoelectric** plethysmograph.
- **Polarographic element** sensing oxygen partial pressure in respiratory gases.
- **Simple one-transistor** recorder of transient skin response. This would eliminate slow changes or normal changes in skin resistance, and would respond only to transient cycle physiological responses generated by discrete stimuli.

Some findings resulting from centri-

TWO-LAYERED LIQUID

P-1075

REMOVES CARBON & PAINT FAST!

P-1075* CLEANS QUICK! Rapidly removes carbon deposits, grease, and oil from jet and piston engine parts — strips most paint — excellent for removing zinc chromate primer from anodized aluminum.

P-1075 CLEANS SAFELY! Non-flammable, and non-corrosive to steel, aluminum, zinc, cadmium, magnesium, copper and lead.

P-1075 SAVES MONEY! Economical to use — seldom requires dumping! Excellent for either large or small shops and for heavy production jobs like engine overhaul.

P-1075 RINSES FREELY! Easily rinsed with hot water or petroleum solvents. Leaves parts bright and clean, ready for inspection or return to service.

P-1075 NEEDS NO HEAT! Use at room temperature — requires no steam or heating. Excellent for use at outlying points or in shops where extra heat is not available.

For more details on P-1075 — or information on Wyandotte's other aircraft-cleaning products — call your Wyandotte representative. Or mail the coupon below. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Nietos, California, and Atlanta, Georgia. Offices in principal cities.* *TRADEMARK

Wyandotte CHEMICALS J. B. FORD DIVISION

Specialists in Aircraft-Cleaning Products

MAIL COUPON TODAY!

Wyandotte Chemicals Corporation, Dept. 3123, Wyandotte, Mich.

Please send information on:

- ☐ Paint Removing
- ☐ Aircraft Cleaning
- ☐ Electrocleaning
- ☐ Carbon Removal
- ☐ Metal Cleaners
- ☐ Aluminum Cleaning and Brightening
- ☐ Removing Exhaust Stains
- ☐ Chemical Products for Airframe Manufacture
- ☐ Barrel Finishing
- ☐ Chemical Milling Aluminum and Magnesium

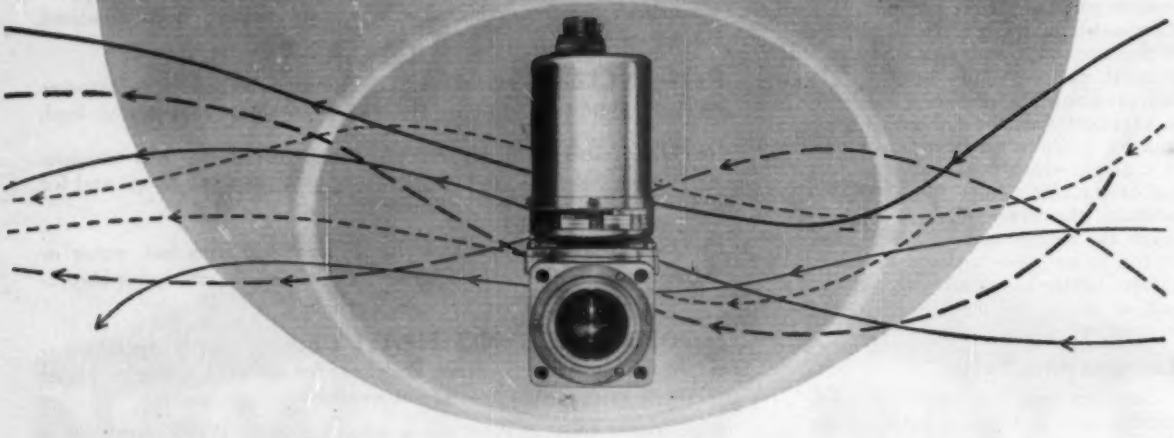
NAME _____ TITLE _____

FIRM _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

WHITTAKER SPHERICAL PLUG VALVES



RELIABILITY—PLUS UNLIMITED SCOPE FOR FLUID-FLOW CONTROL

These compact valves afford split-second control in high pressure and cryogenic flow systems. Whittaker's spherical plug construction provides the efficiency of "straight-through flow" with negligible pressure drop—almost constant low operating torque regardless of pressure ... *for unlimited advantages of flow control!* Available in a wide range of sizes, each valve is designed to customer specifications—may be actuated manually, pneumatically, hydraulically, or electrically. Since 1955, Whittaker Spherical Plug Valves have been produced in quantity for both missile and aircraft applications—let Whittaker engineers help *you* with your design problem. Write, wire, or phone.

Time-proven Reliability
In Hydraulic-Pneumatic-Fuel Controls

WC

WHITTAKER CONTROLS
DIVISION OF TELECOMPUTING CORPORATION

BRANCH OFFICES: New York, Dayton, Seattle, Wichita, Atlanta

915 N. Citrus Ave., Los Angeles 38, Calif. • HO 4-0181

First Vertol YHC-1A Helicopters Near Completion

First three Vertol YHC-1A twin-turbine helicopters for U. S. Army near completion at Vertol's Morton, Pa., plant. Powerplants are twin Lycoming T53 turboshaft engines; seven later aircraft will have General Electric T58-8s. Aircraft is the military version of the Vertol 107 (AW May 18, p. 42) now being demonstrated to U. S. and European government and industry officials. First YHC-1A will make its initial flight this month. Army will order an undisclosed number to replace its inventory of piston-engined helicopters.

fuge simulation of the X-15 research aircraft were outlined by Carl Clark, Aviation Medical Acceleration Laboratory, U. S. Naval Air Development Center, and C. H. Woodling, National Aeronautics and Space Administration, Langeley Research Center.

Flight controls for the X-15 sought a balance between having larger stabilizing surface and their consequent decrease in performance, and adding electronic stability. The compromise was made in such a way, according to Clark and Woodling, that even with electrical failure of the damper systems, a well trained pilot has sufficient aerodynamic stability to still make a successful re-entry under these conditions:

- **If he could tolerate** the accelerations and the oscillations.
- **If his restraint** prevented him from being knocked about.
- **If he could still read** and interpret his instruments while under this stress.
- **If he could still maintain** control of the general flight path without making involuntary pilot inputs to further excite these oscillations.

No Previous Studies

No previous studies have been made of human tolerance to oscillating accelerations of the amplitude and durations expected in this regime of the X-15.

North American utilized the Johnsville centrifuge in the X-15 program by requesting study initially of tolerance and restraint, and subsequently, of instruments, controls, and control techniques as well.

In the period of March, 1957, to July, 1958, three X-15 programs were carried out as a cooperative effort of North American, U. S. Navy, National Aeronautics and Space Administration and Air Force.

Since the Johnsville centrifuge has only 3 deg. of freedom of motion, rather than 6 deg., emphasis for these studies was on simulation of the three linear acceleration components.

As organized, the system provides control of the centrifuge proportional to the pilot inputs; data from the analog computer also serves to drive the pilot's instrument display, giving him the proper reading for the control inputs.

In the second and third X-15 programs at the centrifuge, a total of 991 "static" flights in which the centrifuge was at rest, and 433 "dynamic" flights in which the centrifuge was in motion, were made by seven potential X-15 pilots and 22 others.

The second program showed the potential usefulness of being able to "fly the aircraft before it is built" with the pilot receiving the expected flight loads for carrying out the mission under his own control. This second program showed the great sensitivity of pilot control required to make a successful re-entry following certain damper failures, so a third program was carried out with improved cockpit and computer simulation.

For the second and third programs, the centrifuge had a number of provisions to prevent accidental danger to the pilot, either through g-limit or mechanical stops which prevented the centrifuge moving to a position which would generate dangerous negative g-loads to the pilot, or loads detrimental to the centrifuge itself. Additionally, several observers, including a medical officer, were always on hand to watch both the pilot's reactions through medical instrumentation and through computer data on the centrifuge itself.

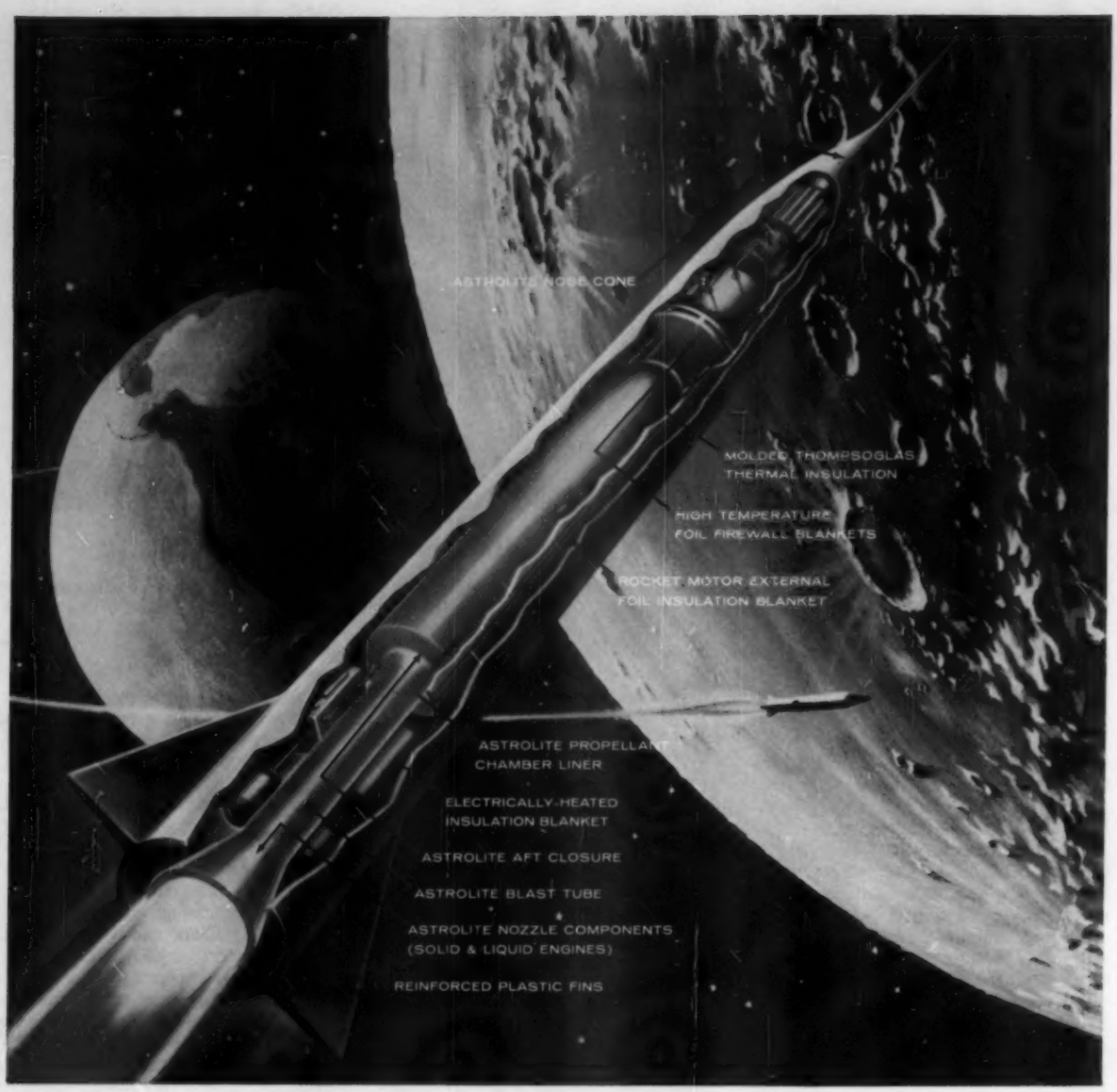
From the centrifuge simulation studies, according Clark and Woodling, it was determined that pilots wearing adequately functioning anti-g suits or the anti-blackout provisions of the various partial or full pressure suits can tolerate the accelerations expected for the X-15 as long as they maintain control of the aircraft.

Pilot Gray-Out

Gray-out was experienced by two subjects in the start of the exit simulation, while being brought up to 2 transverse g. Full vision was regained within a few seconds, presumably by circulatory compensation.

Sensations of tingling and pain can occur with accelerations either forcing blood into or out of dependent portions of the body. At the end of the exit phase, due to the seat of the X-15 being tipped back 12 deg., there is a physiological negative lg vertical forcing blood and fluid into the head. Feelings were reported of fluids rising in the throat, throat constriction, and of some difficulty in swallowing, but these were not particularly disturbing. Respiration and conversation could be carried on.

In the X-15, the legs are extended


ASTROLITE NOSE CONE
MOLDED THOMPSOGLAS THERMAL INSULATION
HIGH TEMPERATURE FOIL FIREWALL BLANKETS
ROCKET MOTOR EXTERNAL FOIL INSULATION BLANKET
ASTROLITE PROPELLANT CHAMBER LINER
ELECTRICALLY-HEATED INSULATION BLANKET
ASTROLITE AFT CLOSURE
ASTROLITE BLAST TUBE
ASTROLITE NOZZLE COMPONENTS (SOLID & LIQUID ENGINES)
REINFORCED PLASTIC FINS

MISSILE DESIGN WITH HITCO IN MIND

Missile design is probably the world's most exacting technology relative to the need for high temperature insulation materials.

HITCO is one of the world's leading developers and manufacturers of ultra-performance thermal materials capable of resisting extremely high temperatures, even up to 15,000°F. for short duration!

If you are looking for down-to-earth answers for out-of-this-world high temperature problems, keep HITCO in mind in your Missile Design!

- **REFRASIL Materials**
- **HITCO Metal Blankets**
- **THERMO-COUSTI Materials**
- **THOMPSOglas Materials**
- **ASTROLITE Reinforced Plastics**
- **HITCORE Structural Core Materials**

Call or write us for Capabilities Brochure and complete Technical Data on HITCO Products.

H. I. THOMPSON FIBER GLASS CO. *1733 Cordova Street • Los Angeles 7, Calif. • REpublic 3-9161*

WRITE OR CALL YOUR NEAREST HITCO REPRESENTATIVE: EASTERN: Tom Kimberly, 38 Crescent Circle, Cheshire, Conn., BR. 2-6544; Fred W. Muhlenfeld, 6659 Loch Hill Rd., Baltimore 12, Md., VA. 5-3135 • **MIDWEST:** Burnie Weddle, 3219 W. 29th St., Indianapolis 22, Ind., WA. 5-8685 • **SOUTHWEST:** Marshall Morris, 2850A W. Berry, Rm. 7, Fort Worth, Tex., WA. 4-8679 **NORTHWEST:** J. L. Larsen, 5757 Oaklawn Pl., Seattle, Wash., PA. 5-9311 • **CANADIAN PLANT:** THE H. I. THOMPSON CO. OF CANADA LTD., 60 Johnston St., Guelph, Ont., TA. 2-6630

forward to the rudder pedals and during the exit phase their blood supply was reduced, generally without discomfort. During re-entry, particularly with speed brakes open, in which deceleration could reach minus 4 transverse g, blood distended the arms and legs. With speed brakes closed, tingling of the legs rarely occurred, but with speed brakes open, particularly after the pilot had made a number of runs, tingling and occasionally slight pain would develop, and the hand or foot might not feel entirely normal for as long as 2 hr. (and in one case, 12 hr.) after the centrifuge runs. In some cases, inflation of the anti-blackout suit, due to the different accelerations, augmented the tingling sensation.

These tingling sensations, caused by blood near the surface of the skin, were largely eliminated by wearing elastic stockings or by elastic bandages and by wearing gloves and tightly laced boots. For these accelerations, and since it is not expected that one pilot will fly the X-15 more than once in one day, these precautions are not required. Use of the airplane's normal restraints also helps to withstand these acceleration results.

Abdominal Strain

Straining by abdominal constriction, generally with open glottis to allow continuation of the respiration, was used by most pilots to resist effects of gray-out. Under acceleration, particularly during the brief period of concentrated effort and high acceleration of the pull-out during re-entry, respiration tended to become more rapid and shallow as evidenced by motion pictures. Pilots frequently sweated during these runs, both because of the heat of the equipment, including motion picture lights, and as symptoms of the stress. It was attempted to avoid fatigue by limiting pilot sessions in the centrifuge.

Under conditions of pilot control of the vehicle with aerodynamic force, subjects in these programs favored the high deceleration even up to gray-out levels when they felt they had adequate control to minimize duration of straining. If control was more difficult due to an experimental condition of reduced control augmentation, they accepted lower decleration to ensure they would not exceed tolerances during a possible aircraft oscillation.

Purpose of the X-15 restraint and body support system is to provide comfort and limit involuntary motions of the pilot. A buttocks-contoured seat, carved from balsa wood, was used in this simulation. The seat prevents submarining of the pilot down and forward within his harness.

The seat has the current aircraft configuration of approximately 12 deg. back tilt. With the rocket acceleration of the aircraft to above 4 transverse g, just before burnout this back tilt subjects the pilot to a physiological acceleration component of approximately −1g vertical, or one negative g, forcing the blood to the head and slight discomfort. If the aircraft accelerated to higher levels, this negative g would become uncomfortable, and could be dangerous.

Pilots wore an integrated harness with shoulder straps secured to the seat back. In the first X-15 work, the pilot was displaced upward in the seat by the physiological negative g component during the exit. This pushed the pilot's head against the top head bumper, resulting in a load on his neck. For subsequent work, the lap belt was moved so that it provided greater protection against motions in this plane. However, when the harness is properly tight, shoulder motion is prohibited and restricted work volume of the hands results. This necessitated a compromise according to each individual pilot's physical size, as to his positioning of the seats and straps.

Another problem is head positioning during fore and aft accelerations and decelerations during re-entry. It was determined in the program that a restraint of some type is required for the pilot, otherwise his head may be forced forward on to his chest, preventing his seeing his instruments and adequately controlling the aircraft during the re-entry.

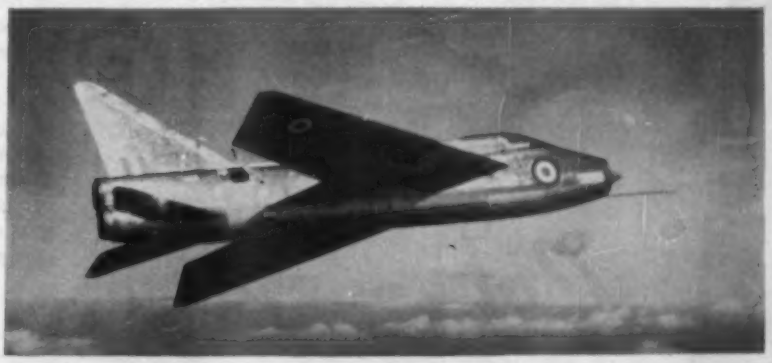
Methods used in the centrifuge to hold the pilot's head would be unuseable in an airplane. An alternate idea was developed of mounting a hinged bumper at the front of the head contacting the helmet over the forehead. It was spring-loaded, could be moved quickly out of the way and secured by the pilot as would be required in case of a bailout. This support, in conjunction with the fixed lateral back and top walls of what might be called a helmet socket, provided adequate head restraint. It is probable this form of head restraint will be used in the X-15.

Pilot display for the X-15 was used in the second and third programs. During exit and ballistic phases of flight, the primary instrument is the attitude indicator in center of the panel, with its associated indicators. Also the angle of attack indicator, and with greater sensitivity at high altitudes, the normal loads accelerometer are viewed and held at zero and the compass is held at desired heading, once the initial exit flight path is obtained. The attitude indicator is a three-gimbaled ball indicating roll, pitch and yaw. Yaw is indicated by the upper hemisphere moving with respect to the lower hemisphere, while roll and pitch are indicated by corresponding motions in both hemispheres. In front of the attitude ball are two ILS-type cross pointers. A vertical pointer indicates side slip (± 20 deg. full scale) as the horizontal pointer indicates angle of attack ± 3 deg. full scale, for use in ballistic phase of the flight.

Visual Field

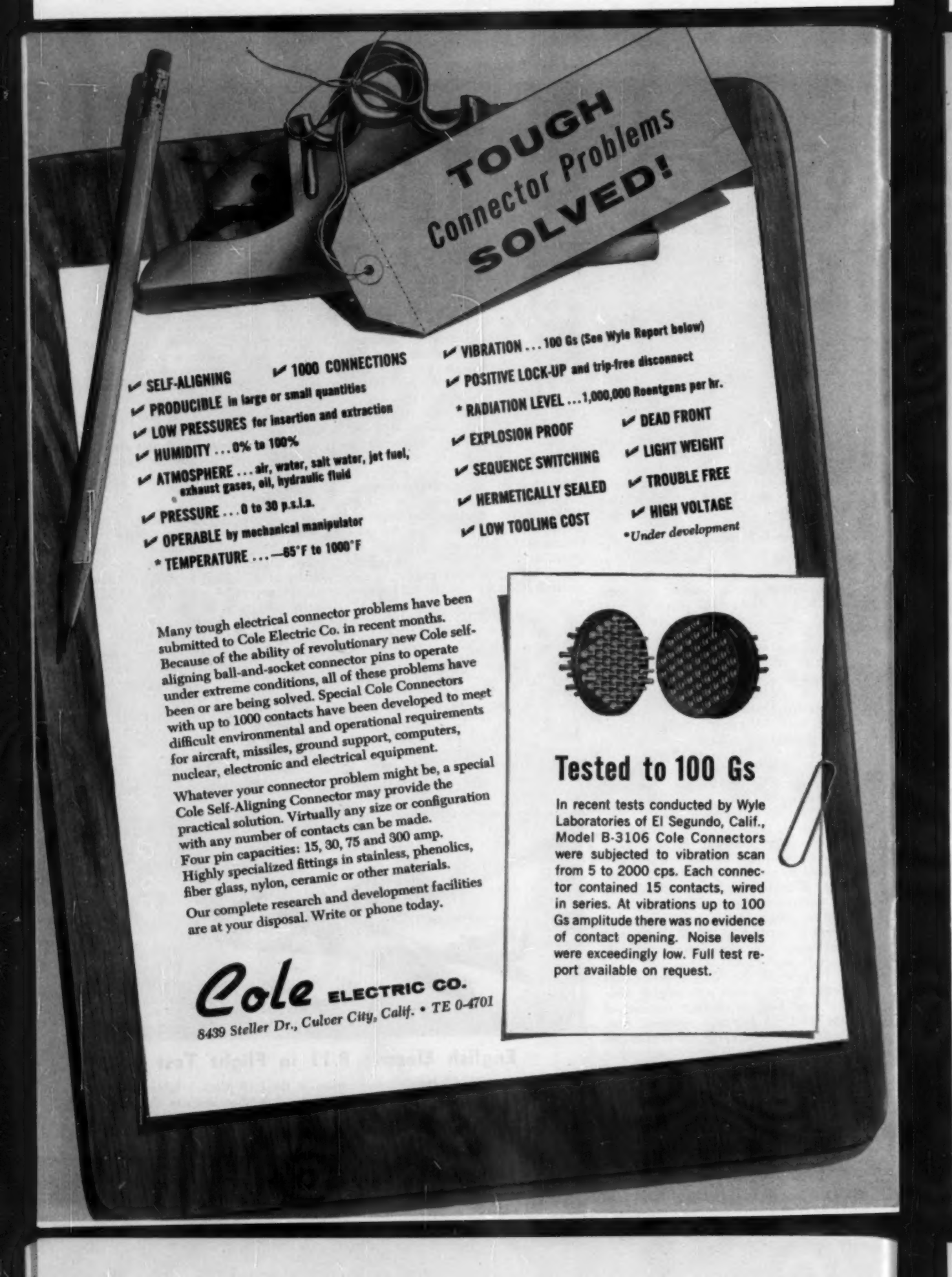
These pointers were added to this instrument following the second centrifuge program as a means to bring more important instruments into the center of the visual field. Instruments whose movements are apparent under static conditions are less likely to be noticed under acceleration. In addition, gray-out may limit peripheral vision. Therefore, as many as possible of the principal attitude indications were combined in this single presentation.

When the attitude indicator shows a significant pitch angle, it is more difficult to sense roll from the attitude ball, so a separate roll index, moving around the ball, is provided. When roll oscillation was developed, it be-



English Electric P.11 in Flight Test

English Electric P.11 side-by-side trainer version of the P.1B Mach 2 fighter has made its first flight at the company's test center at Wartoa, Lancashire, and now is in its flight test phase. Reshaping of fuselage contours around the expanded cockpit was done with careful area-ruling. Two-seater probably could be modified to an all-weather version if the Royal Air Force decides a two-man operation will be necessary for such missions.



- ✔ SELF-ALIGNING
- ✔ 1000 CONNECTIONS
- ✔ PRODUCIBLE in large or small quantities
- ✔ LOW PRESSURES for insertion and extraction
- ✔ HUMIDITY . . . 0% to 100%
- ✔ ATMOSPHERE . . . air, water, salt water, jet fuel, exhaust gases, oil, hydraulic fluid
- ✔ PRESSURE . . . 0 to 30 p.s.i.a.
- ✔ OPERABLE by mechanical manipulator
- * TEMPERATURE . . . —65°F to 1000°F
- ✔ VIBRATION . . . 100 Gs (See Wyle Report below)
- ✔ POSITIVE LOCK-UP and trip-free disconnect
- * RADIATION LEVEL . . . 1,000,000 Roentgens per hr.
- ✔ EXPLOSION PROOF
- ✔ DEAD FRONT
- ✔ SEQUENCE SWITCHING
- ✔ LIGHT WEIGHT
- ✔ HERMETICALLY SEALED
- ✔ TROUBLE FREE
- ✔ LOW TOOLING COST
- ✔ HIGH VOLTAGE

Under development

Many tough electrical connector problems have been submitted to Cole Electric Co. in recent months. Because of the ability of revolutionary new Cole self-aligning ball-and-socket connector pins to operate under extreme conditions, all of these problems have been or are being solved. Special Cole Connectors with up to 1000 contacts have been developed to meet difficult environmental and operational requirements for aircraft, missiles, ground support, computers, nuclear, electronic and electrical equipment.

Whatever your connector problem might be, a special Cole Self-Aligning Connector may provide the practical solution. Virtually any size or configuration with any number of contacts can be made. Four pin capacities: 15, 30, 75 and 300 amp. Highly specialized fittings in stainless, phenolics, fiber glass, nylon, ceramic or other materials.

Our complete research and development facilities are at your disposal. Write or phone today.

Tested to 100 Gs

In recent tests conducted by Wyle Laboratories of El Segundo, Calif., Model B-3106 Cole Connectors were subjected to vibration scan from 5 to 2000 cps. Each connector contained 15 contacts, wired in series. At vibrations up to 100 Gs amplitude there was no evidence of contact opening. Noise levels were exceedingly low. Full test report available on request.

Cole ELECTRIC CO.

8439 Steller Dr., Culver City, Calif. • TE 0-4701

came useful to use a roll-rate meter below the attitude ball. This meter is the moving airplane index type, in which the airplane is visualized as moving with the pointer and having the roll rate given by the moving pointer position. One then must "fly from" the moving index, making control motions in the opposite direction from the pointer motion to obtain the desired position.

In making the transition from the use of the roll position index, to the use of the roll rate index, the direction of motion of controls must be the same in response to a motion of the indices, for a control move in the wrong direction may easily be made during this transition. Therefore, pilots subsequently learn to watch not the motion of the horizon, nor the top of the roll index, but rather the motion of the bottom roll index which would move to the left when the left wing went down, and when the roll rate index moved to the left. Roll correction was provided by moving the control to the right.

Problem of display design, as to whether the pilot moves control in the same or opposite direction to that of the moving part, was settled by pilot preference and by learning. Resultant combination was both a moving airplane and stationary airplane combination.

Oscillation Magnitude

In roll control, overcompensation for an induced movement will produce further oscillations, leading to "getting in phase" or increasing the magnitude of the oscillation. The X-15 program showed that pilots had the tendency not to attempt to damp out the high frequency oscillations, but rather let them be damped by the inherent dynamic stability of the aircraft. The damping occurs rapidly with control augmentation, but not so rapidly without the augmentation. Pilot's control means roll position by very slow roll inputs, in order not to excite further oscillations.

During re-entry the pilot scans the angle of attack, normal acceleration, roll angle and rate, side slip angle, compass, and climb or dive rate instruments. To avoid "bouncing" back to a higher altitude following descent, he must note when the dive rate instrument passes through the zero reading so he can release his pullout control inputs.

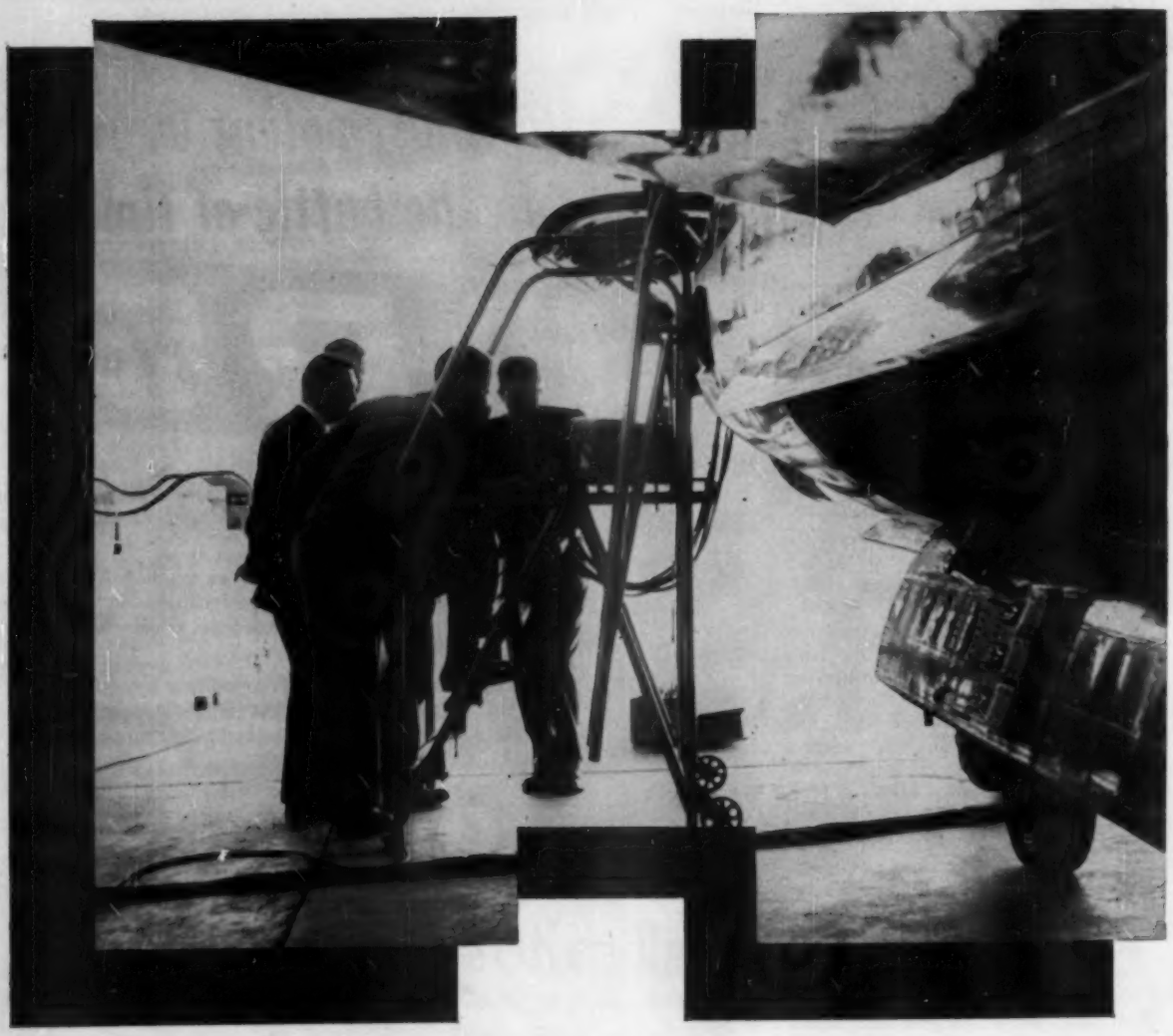
For the second program, the dive rate instrument was to the upper right of the panel and many pilots "bounced." For the third centrifuge program and probably for the X-15, this instrument is brought in beside the attitude indicator so the pilots will more readily detect completion of the pullout without bouncing. To further reduce the scan required of the pilot during re-entry, a combined instrument with multiple needles giving angle of attack, normal load, low angle, and dive rate has been suggested.

As the X-15 leaves level flight, a coupling of forces and motions in the display occurs. This problem becomes particularly severe when one tries to fly the X-15 (in simulation) straight up or turn it around while above the atmosphere. Development of displays is recommended which uniquely indicate, at any heading angle, which control should best be used to correct the display deviation. To give pilots further experience with the X-15 panel in addition to their work in static simulators and with certrifuge simulators, this panel is being installed in a high performance jet aircraft.

While it was noted that all the equipment of the cockpit has not been provided in the centrifuge simulator, initial emphasis was on the pilot's tolerance and his ability to carry out control tasks in spite of oscillations which may develop during re-entry. Now that it is known that pilot can carry out his primary control tasks, it will be important to examine and possibly simulate certain of his secondary tasks in the centrifuge, which might interfere with

Our most potent weapon
in the battle of time:
QRC*
In advanced military electronics research, the ability to do the job isn't good enough. The job must be done reliably and on time.
Hallicrafters' QRC program was originated to provide not only the finest of engineering facilities and people, but the flexibility required for immediate, crash effort on critical electronics problems.
Hallicrafters has provided our military forces for the past six years with a Quick Reaction Capability that has played a major role in helping to win the battle against time.
* Quick Reaction Capability: Refer to Air Force Reg. No. 80-32
The tough jobs get off the ground in a hurry at . . .
hallicrafters
Chicago 24, Ill.
Qualified Engineers: new contracts have created openings. Contact William F. Frankart, Director of Engineering.

Flying brains need



clear heads

...and keeping them "thinking" clearly is the job of the Hughes Field Engineer. Invariably you'll find him in the company of top armed services and aircraft manufacturer's personnel. As in the photo at far left, his laboratory is in the field, evaluating a highly advanced Hughes Electronic Weapons System.

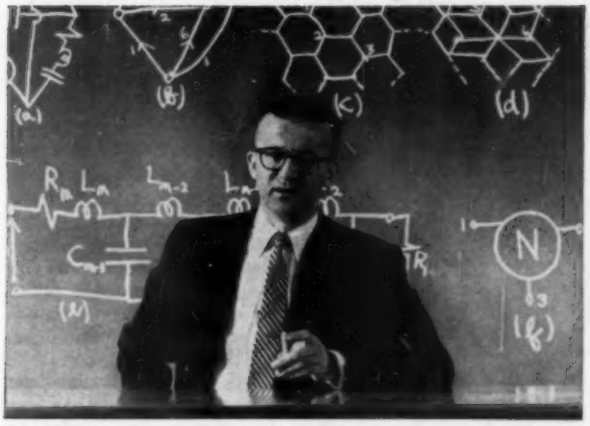
Drawing on a firm base of training in the total system, he judges and evaluates its performance. One of his key jobs is suggesting basic modifications. Simultaneously, he maintains close liaison with Hughes manufacturing groups to insure the highest standards of reliability.

The Hughes Field Engineer is typical of engineers and scientists throughout the Hughes organization. Here, the individual is given every opportunity to work out his ideas, to add measurably to his professional stature.

At Hughes Ground Systems Division, for example, engineers and scientists are now exploiting a major breakthrough—3-D radar. This new development is acknowledged as the most significant progress step since radar itself was discovered.

At Hughes Products, advanced work is being done on a variety of automatic control systems, microwave tubes and new semiconductor devices.

Whatever your field of interest, you'll find Hughes diversity of advanced projects makes it the ideal place for you to grow... both professionally and personally.



NETWORK SYNTHESIS *is one of the many areas of study at Hughes Research and Development Laboratories. This work includes lumped and distributive parameter systems, both passive and active.*

TESTING THE TESTERS—*At Hughes Advanced Electronics Manufacturing Division, test equipment designed and built for Hughes Weapons Systems is often as sophisticated as the systems themselves!*

Newly instituted programs at Hughes have created immediate openings for engineers experienced in the following areas:

Communications	Environmental Engineering
Industrial Systems	Logical Design
Electron Tubes	Radar Circuit Design
Field Engineering	Material & Component Eng.
Semiconductors	Systems Analysis
Test Equipment Eng.	Systems Management

Write in confidence, to Mr. John Case, Hughes General Offices, Bldg. 6-A6 Culver City, California.

© 1959, H. A. C.

The West's leader in advanced ELECTRONICS

HUGHES

HUGHES AIRCRAFT COMPANY
Culver City, El Segundo, Fullerton and Los Angeles, California
Tucson, Arizona

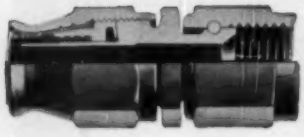
Fluoroflex-T *(Teflon)*

PLUMBING

engineered for **SAFETY, RELIABILITY**

PREFORMED CONFIGURATIONS. Factory preformed to meet specific routing requirements for almost any configuration. Preforms are stress relieved at the bends, permitting tighter bend radii than free hose.

SPECIAL FITTINGS. Fabricated to any specified angle or configuration from stainless steel, carbon steel, or aluminum alloy. Compound and less than 1:1 bends to aircraft tolerances; certified welding and brazing.



SEAL-LOCK FIELD ATTACHABLE, REUSABLE FITTING. Designed for maximum flexibility in teststand and mockup work. Dynamic sealing and triple-locking actions make assemblies leak-proof and blow-off proof. Sizes -3 through -24Z qualified to MIL-H-25579.

SWAGED FIELD ATTACHABLE, PERMANENT FITTINGS. Designed for maximum reliability. Resistoflex swaged fittings have proven their dependability in more than 3 million assemblies. Available in all standard sizes and a variety of configurations including elbows and special attachments.

®Fluoroflex is a Resistoflex trademark, reg., U.S. pat. off.
®Teflon is DuPont's trademark for TFE fluorocarbon resins.

Originators of high temperature fluorocarbon hose assemblies

Resistoflex
CORPORATION Dept. 266

Offices in principal cities
Roseland, New Jersey • Western Plant: Burbank, Calif. • Southwestern Plant: Dallas, Texas.

his primary tasks and tend to increase control difficulties.

Particularly important are secondary tasks associated with emergency procedures such as modified thrust duration, power failure, fire, and oxygen system difficulties. Certain of these peripheral tasks may be included in the proposed fourth X-15 centrifuge simulation program, in which certain unexpected emergencies may be simulated.

Following studies of the X-15 flight trajectory and forces, a right hand aerodynamic control stick which operates hydraulic boosters to provide roll and pitch control which operate even though there may be an electronic system failure, was incorporated.

In line with the idea of minimizing novelties in the X-15, a center control stick also was provided. Determination of the ability to carry out a two-dimensional task was made during the first centrifuge program. While it was found that the tracking errors with the center stick were greater than those with the side stick, it was true at rest as well as under acceleration. Pilots felt that the loading of the center stick was not optimum. During the first program under cam control, pilots developed proficiency in the repeated reproduced acceleration patterns, and performance improved. With the center stick, the greater arm motion and effort and less feeling of support caused most pilots to prefer the right hand stick.

Side Stick Forces

Question of the control forces involved in the side stick installation have been raised. Extremely sensitive controls are subject to involuntary movements which may produce undesirable flight path changes. On the other hand, if the control has too large a breakout force, overshooting of the desired degree of control application may easily occur. If restoring forces on the control are not strong enough, magnitude of the control input can not be ascertained by the usual sensory feedback, and must come either from looking at the control or looking at response of the aircraft on the instruments.

Wearing pressure suit gloves further reduced the normal feedback, allowing unintended inputs to be given to the control during the times when attention was not focused on instruments which would immediately indicate the effects of such control movement.

Program data indicated control sensitivity in roll and pitch, was, if not critical, at least touchy. If in applying roll correction, an undesired pitch change is obtained by unintended dual (pitch plus roll) stick movement, the combination can lead to danger.

Stick also requires perfect dynamic balance to provide proper responses to pilot indicating magnitude of control

inputs. Thus, the pilot had to be trained to watch the instruments in order to immediately ascertain changes in attitude during critical flight regimes, since control positions were not adequate to sense this all the time.

Pneumatics of the right hand stick also were improved during these programs.

Left hand ballistic control stick in the centrifuge program was of the "all-or-none" action type. In the third program, control effect proportional to stick deflection was utilized. This stick, with addition of lateral motions of the wrist for yaw control, has three degrees freedom. With experience, pilots learned to make motions in one channel at a time. Control motions of brief durations were made, then the effect observed before the next control applied.

Control Inputs

With the possibility of exciting aircraft oscillations by rapid or excessive aerodynamic control inputs, pilots developed the technique of controlling the mean headings by right hand and rudder aerodynamic control as soon as the aerodynamic pressure allowed this, at the same time using left hand ballistic control to damp oscillations. Restoring forces of the ballistic control were such that brief and abrupt terminating control inputs could be made. Ballistic control could be used as an "all-or-none" type, whereas aerodynamic control is continuous. Some proposed combining the two-in-one stick, but this is not recommended by Clark and Woodling.

Clark and Woodling recommended at least 10 hr. of static simulator training prior to centrifuge flights of the X-15 research aircraft in order that these pilots would be able to maintain control while experiencing flight loads under their own control. In addition, pilots work better if they are adequately fitted in restraint, are well rested, with proper operating anti-blackout equipment, and if they have had previous high acceleration experience.

They noted that a fourth X-15 centrifuge simulation program is planned after initial flight data has provided confirmation or indicated necessary improvement of the mathematical representation of vehicle characteristics. This program would include a study of pilot response to simulated unexpected emergency conditions. Centrifuge training will provide a background so that these pilots will not be distracted by accelerations in combination with emergencies. It will be used to further study pilot control capabilities under extreme simulated conditions of altitude, modified boosters, reverse thrust, etc.

SUB*Minax*® *look* delicate–
but read how tough they are!

SUBMINAX RF connectors are AMPHENOL's sophisticated design solution for RF miniaturization programs. These are subminiature connectors with full size electrical and mechanical capabilities. For example:

Strength: Cable retention force of Subminax assemblies is 20 pounds

Insulation Resistance: 1,000,000 Megohm

Dielectric Withstanding Voltage: 1500 Volts RMS 60 Cycles minimum

The Subminax family is a large one, too. Standard and Field Serviceable designs are available in 50 or 75 Ohm Impedances with Push-On or Screw-On coupling. All popular RF connector constructions are included.

Write for Subminax cataloging and collateral technical data.

AMPHENOL CONNECTOR DIVISION

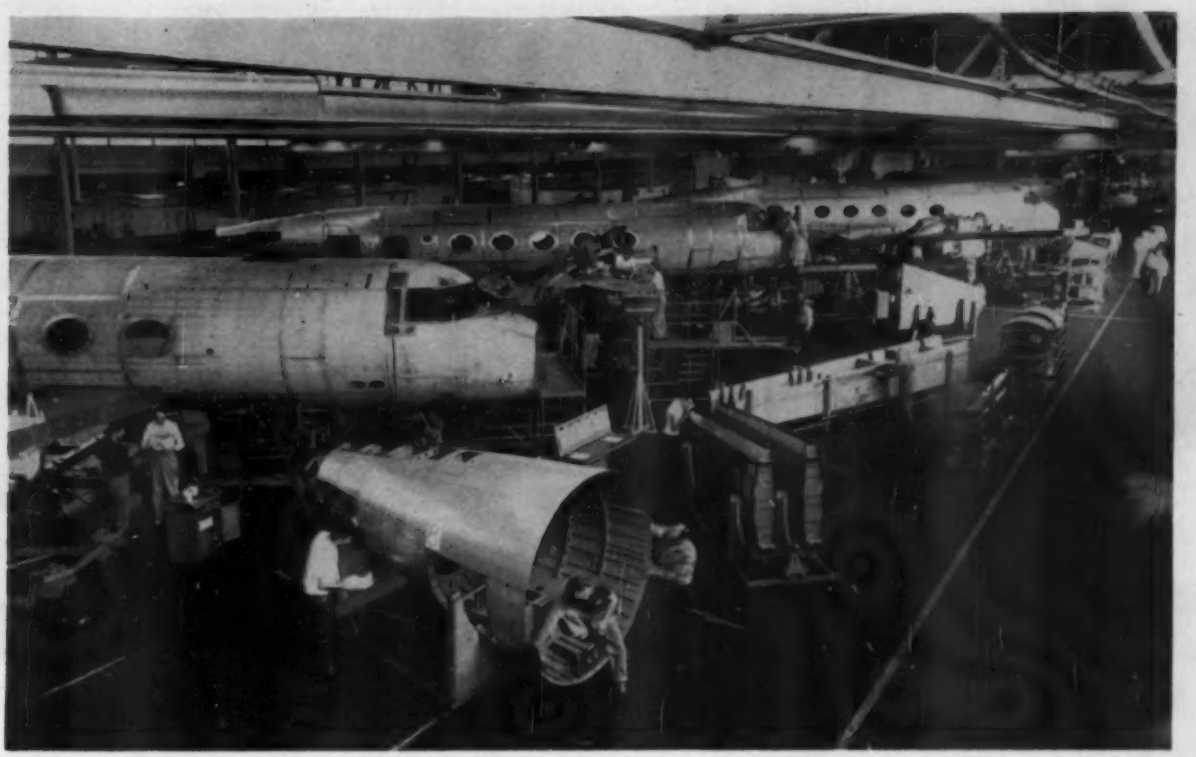
Amphenol-Borg Electronics Corporation

CHICAGO 50, ILLINOIS

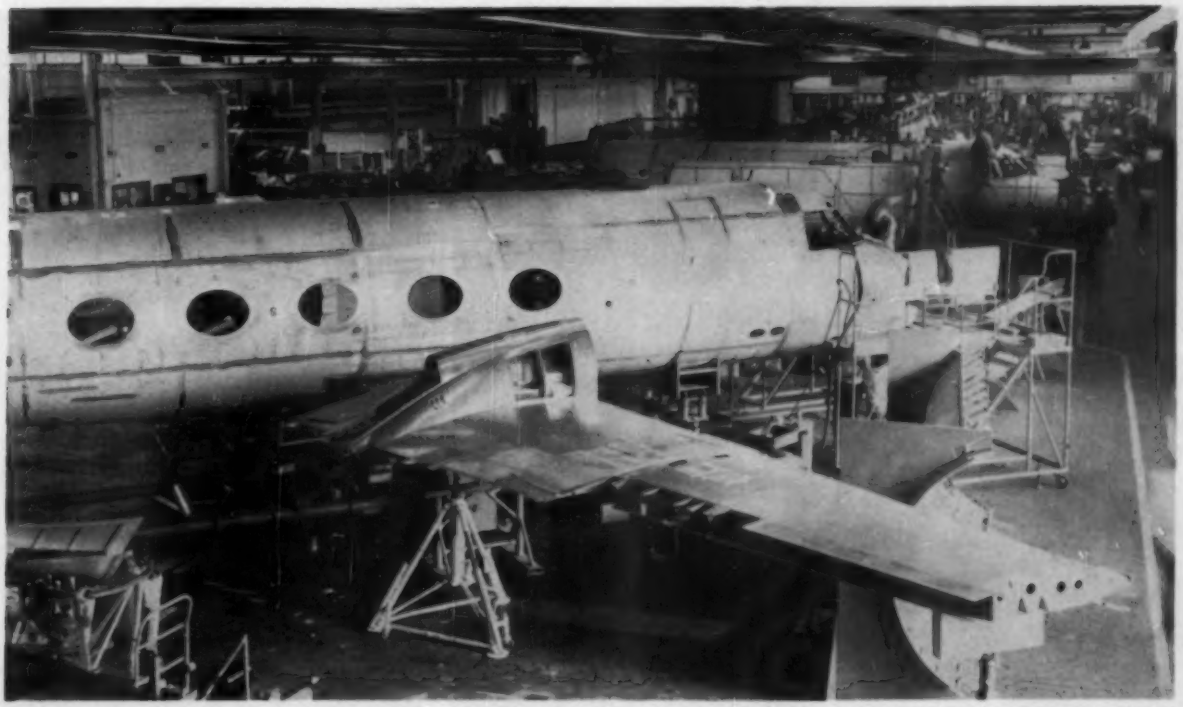
Grumman Aircraft Engineering Corp. Gulfstream No. 3 will be used by the manufacturer as a sales demonstrator and will begin a tour of Gulfstream distributors this month. Grumman currently has firm orders, with substantial deposits, for approximately 32 Gulfstreams.

Grumman Producing Three Gulfstreams per Month

Gulfstream No. 2 (left above) will be leased to a government agency. No. 3 is shown at right above before it was painted. No. 4 (below) will be the first of the turboprop executive airplanes to be delivered to a customer; Grumman expects to make delivery this week.



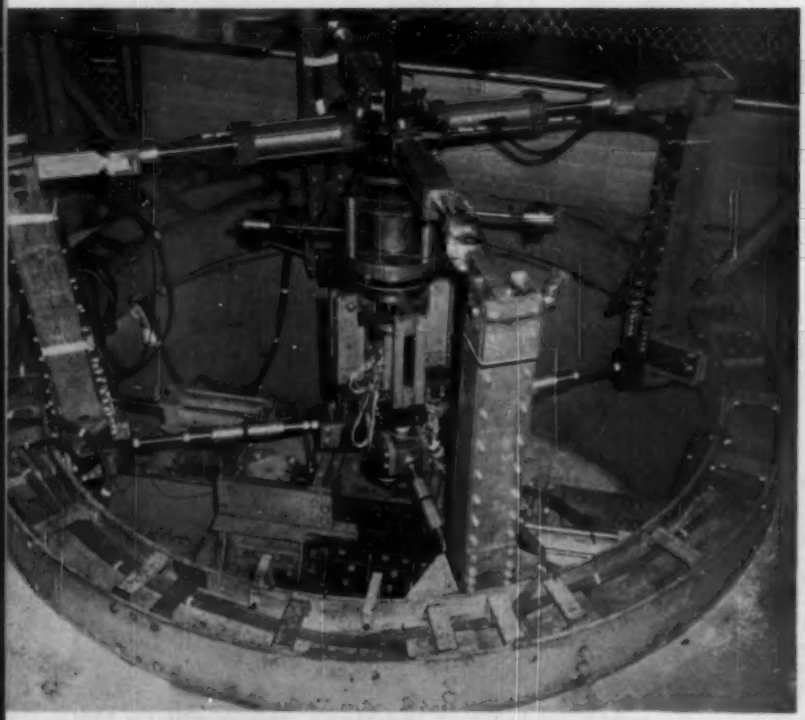
Production of Gulfstream turboprop 10-12 passenger executive transport is proceeding on a three-a-month schedule at Grumman's plant in Bethpage, N. Y. One of the first major components for aircraft No. 18 is currently being fabricated—the cockpit floor. Four airplanes are on flight status and two more are completed and are undergoing instrumentation for flight tests. The Gulfstream recently received final Federal Aviation Agency type certification (AW June 1, p. 37). Fuselages, left to right, are Nos. 8, 7 and 6.

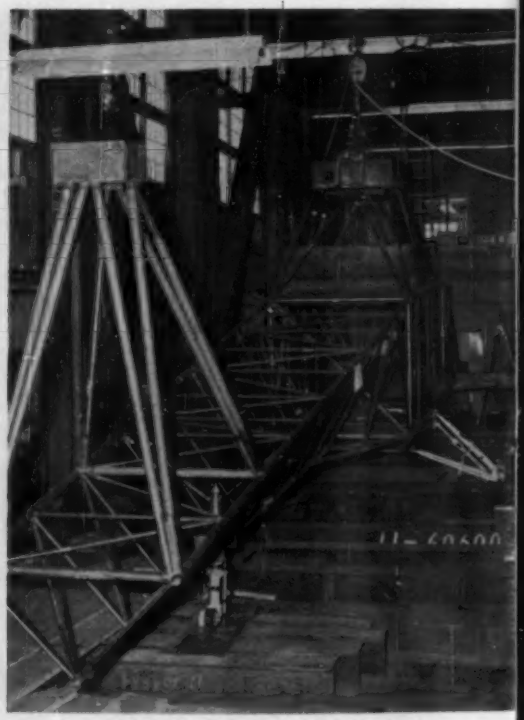


Gulfstream No. 6 is shown in closer view. The executive plane is powered by two Rolls-Royce Dart RDa. 7/2 turboprops rated at 2,105 eshp. each. Fail-safe and safe-life structural design is aimed at providing a fatigue-free airframe life of approximately 20,000 flight hours (AW Sept. 22, p. 82). Circular fuselage has an outside diameter of 94 in. and an inside diameter of 88 in. Headroom inside the cabin is 73 in. without obstructions. Stringers in the cabin area are 7.5 in. apart. Pressurized portion of fuselage is 41.5 ft. long.

Kaman HU2K-1 all-weather helicopter for U. S. Navy undergoes 50 hr. preflight ground testing at Bloomfield, Conn. Pilot is testing the General Electric T58 turbine engine prior to transfer of controls to a test blockhouse. Navy has ordered four HU2K-1s (AW Jan. 20, 1958, p. 79). Fairings and doors have been removed to facilitate easy access during the test operations.

Kaman Ground-Tests HU2K-1 Turbine Helicopter,



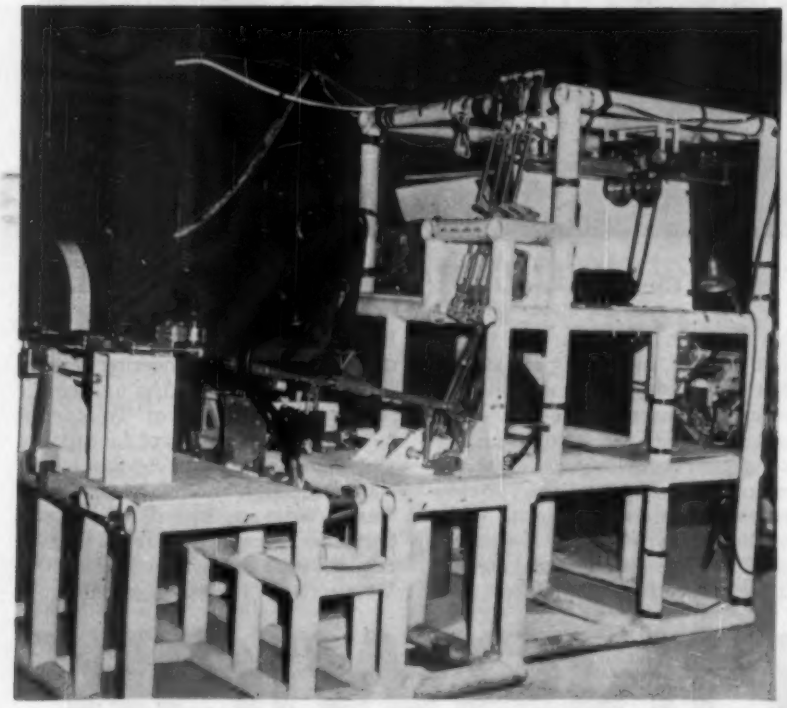


Rotor hub fatigue test rig (left) is used to determine the fatigue life of the main rotor hub, with all flight operational loads imposed simultaneously. About 12 ft. in diameter, the rig provides complete flexibility for varying stress levels and changing loads. At right is a full-scale dynamic model of the HU2K-1 which incorporates the same mass and inertia distribution of the actual helicopter.

Wind tunnel imposes flight load on HU2K-1 three-bladed tail rotor, shown here connected to the helicopter's empennage section. Both main and tail rotors feature rapid manual folding. Four-bladed main rotor uses Kaman aerodynamic servo-flap control.

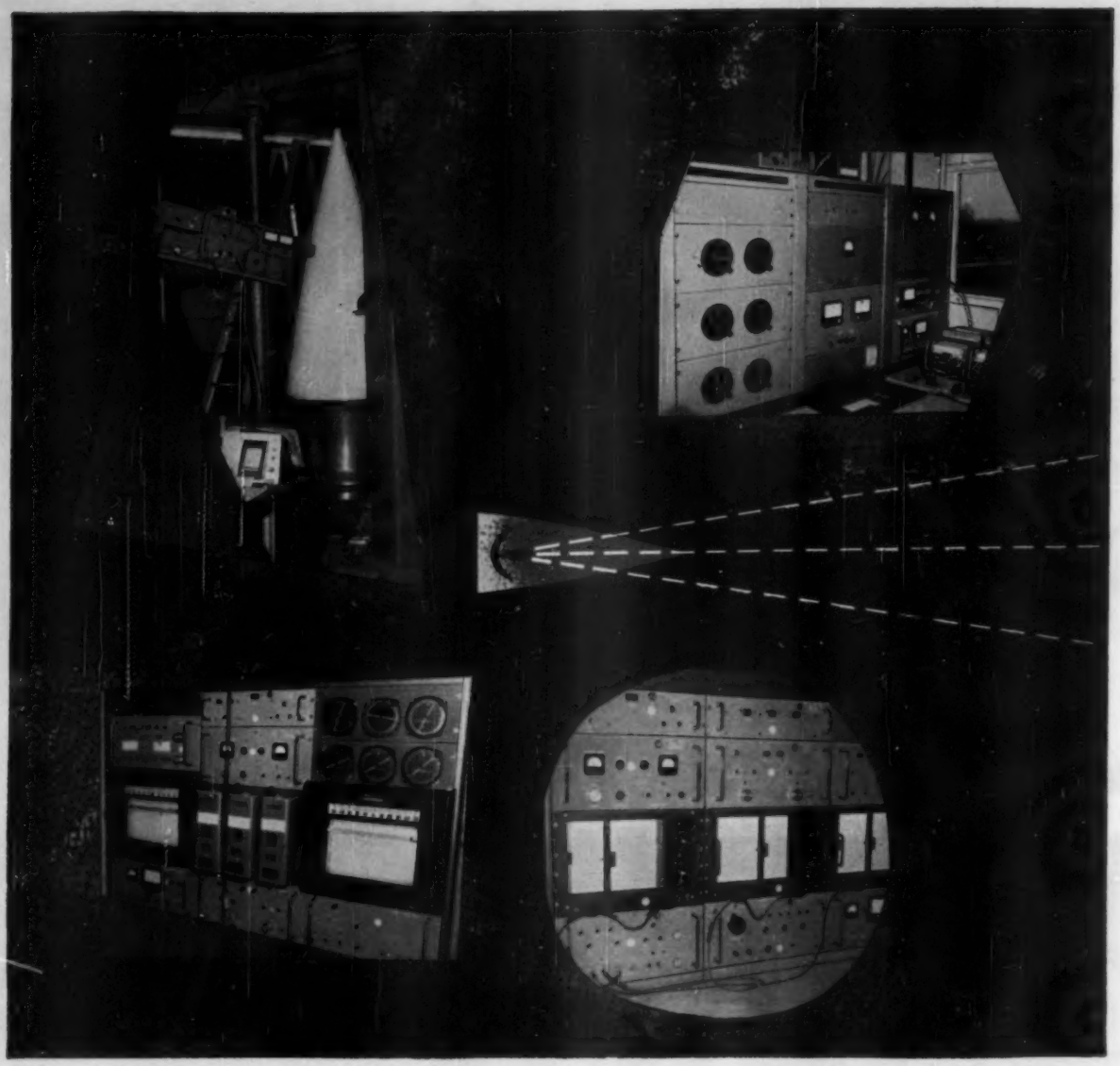
Kaman drone helicopter for Navy has same engine and rotor drive as the HTK helicopter. Aircraft is flown off ground dolly; blades shown here are cropped for demonstration.

Radio-Controlled HTK Drone



Test rig for HU2K-1 automatic stabilization equipment is Kaman-designed; ASE uses mostly off-the-shelf components. Aircraft will be equipped with Automatic Dead Reckoning Navigation System (ADRN) to simplify all-weather operations.

Production drone probably would be equipped with a turbine engine. Stores would be attached to cargo hooks either in a sling or a pod. Drone is controlled from the ground by radio.



BORESIGHT ACCURACY TO 1/15 MILLIRADIAN? SEE BRUNSWICK

Brunswick-built radomes are setting new highs not only for strength-to-weight ratios, but accuracy as well. The reasons for the accuracy are simple: Brunswick has the test facilities and know-how that are without peer in the industry. Three radome ranges which automatically detect boresight error to an accuracy of 1/12 to 1/15 milliradian are now in full operation at Brunswick.

Soon to be in operation: two 1,000-foot ranges, manually operated, that will assure even more refined accuracy, detecting errors as small as 5 seconds of arc. Also, as an aid to design, quality control and maintenance of electrical tolerances, Brunswick is currently utilizing a one-horn interferometer for accurate IPD measurements and corrections before final range testing.

Behind these extensive test facilities operates an engineering team skilled in both detecting and *correcting* boresight error. To learn how this combination of facilities and engineers can give you uniquely accurate, tough and lightweight radomes, write to: Brunswick-Balke-Collender Company, Defense Products Division Sales Manager, 1700 Messler St., Muskegon, Michigan.

BRUNSWICK

MAKES YOUR IDEAS *WORK*

27,500 LB. McDonnell F3H-2M Demon is accelerated to 145 kt. during a 248 ft. run on the Navy's C-14 internal combustion catapult at Naval Air Test Facility, Lakehurst, N. J. Catapult, which has 50% greater launching capacity than conventional steam systems, is designed for use on super aircraft carriers. Total energy output is 70 million ft. lb. Reaction Motors is powerplant producer.

Navy Tests Internal Combustion Catapult

Lakehurst, N. J.—First catapult launch, using the Navy's C-14 internal combustion catapult was completed at the Naval Air Test Facility here with the launching of a Grumman F9F-8 fighter.

The catapult, which has 50% greater launch capacity than conventional steam systems, is intended for use on new super carriers.

The catapult powerplant produces a total energy output of 70 million ft. lb. and is designed to launch a 100,000 lb. aircraft at 125 kt., or lighter aircraft at speeds up to 175 kt.

Launch Demonstrations

The two demonstration launches did not come close to taxing the system's capability.

- **Grumman F9F-8,** the first aircraft launched, piloted by Cmdr. R. C. Tylutki, weighed 17,500 lb. and reached an end speed of 139 kt.
- **McDonnell F3H-2M,** the 27,500 lb. Demon, flown by Lt. Cmdr. John Schaeffer, was accelerated to 145 kt. during the 248 ft. catapult run.

Both aircraft were launched into a light left crosswind by the catapult, which heads down an 8,000 ft. runway.

Reaction Motors Division of Thiokol Chemical Corp., producer of the C115 catapult powerplant, will deliver four units to the Navy late this year. The powerplants are the result of Navy development contracts to Reaction Motors which began in 1949.

Advantages of the C-14 combustion catapults over conventional steam catapults (C-13) include:

- **More powerful** combustion catapults can launch heavier aircraft at faster speeds. This is in line with the Navy's constant effort to make its carriers compatible with high performance aircraft.
- **Independence** of the ship's steam system of the combustion catapults is important in the case of proposed nuclear carriers with their low pressure systems. Even conventional carriers experience a severe steam pressure drop when maintaining high speeds during heavy launch schedules. Another advantage is that the C-14 catapult requires less water than steam systems.
- **No preheating** of the catapult tube is required with the new catapult, as is necessary with the steam type.

The combustion catapult powerplant, first described in Aviation Week (Sept. 2, 1957, p. 91), burns a mixture of JP-5 jet fuel and compressed air. Reaction Motors originally experimented with liquid oxygen as the oxidizer. This was dropped in favor of compressed air for the same reasons that led the Navy to solid propellant rockets: the rather complicated logistics of maintaining a safe adequate supply of liquid oxygen aboard ship.

JP-5 was an obvious fuel choice due to its availability in quantity aboard aircraft carriers.

The JP-5 and compressed air are stored under pressure in individual accumulators.

When the catapult is fired, the propellants are injected into the combustor head, mixed, and ignited by a flameholder.

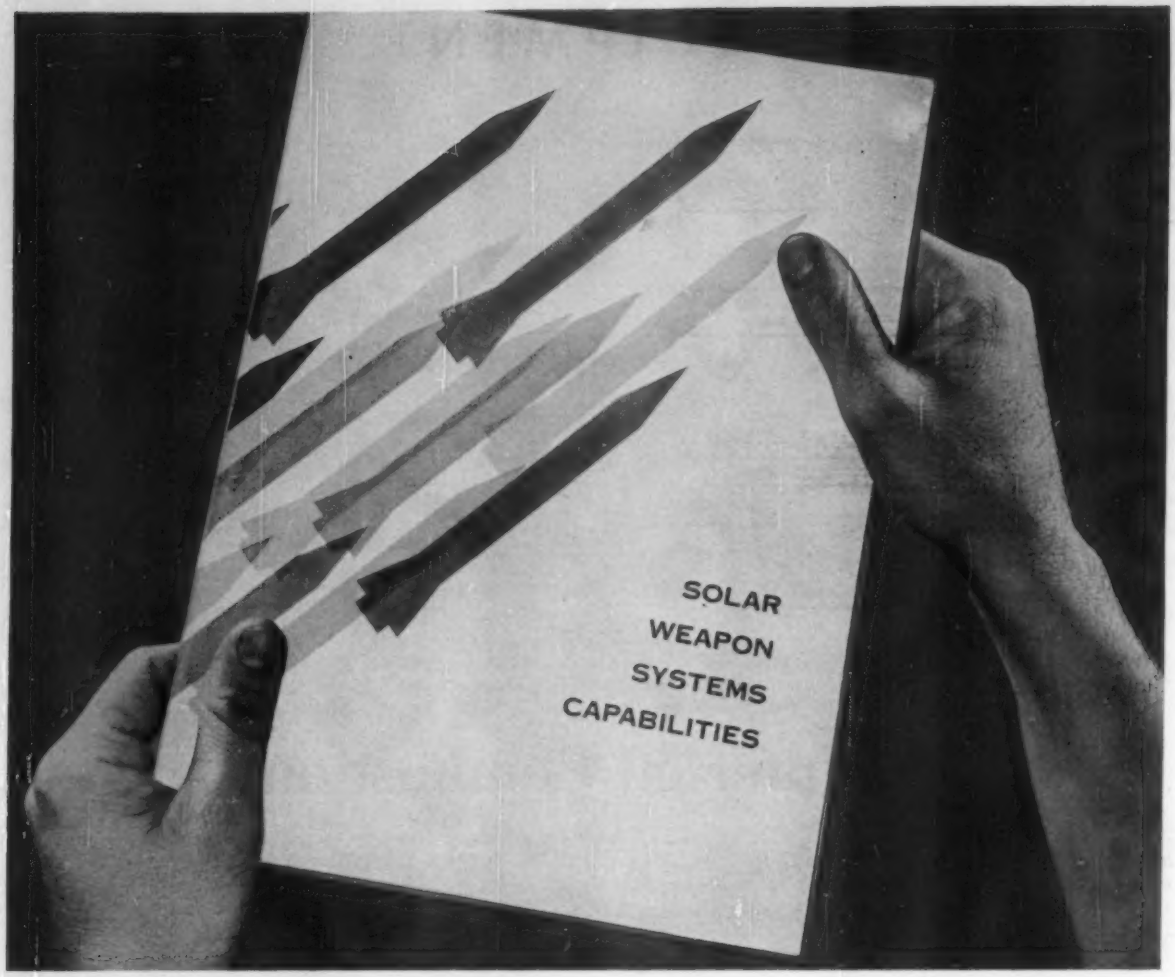
Prior to entering the catapult engine, the hot combustion gases are cooled by water injection to 600F.

The resultant steam/nitrogen mixture drives the piston down the slotted catapult tube.

Cylinder Pressure

Constant catapult cylinder pressure is maintained throughout the piston stroke by means of a servo control system which positions the air, fuel and water control valves. Necessary system pressure is determined by the weight of the aircraft to be launched and the desired end speed.

During a maximum energy shot, the combustion catapult will consume 880 lb. of air, 44 lb. of JP-5 and 400 lb. of water. Aircraft end speeds can be varied from 60 kt. (4.88 sec. duration) to 175 kt. (185 sec. duration.) Reaction Motors says the powerplant will maintain within ±5% of desired system pressure. The powerplant is used with conventional 248-ft. steam catapult tubes.



Send for this important new brochure!

Learn how Solar's far-sighted weapon systems team and advanced facilities can step up your program

SOLAR'S WEAPON SYSTEMS capability combines more than three decades of research and development leadership in aircraft and missile technology, with complete manufacturing and test facilities. Responsibility for Solar's advanced systems program is centered in a team of experts experienced in the many phases of systems development—from conception to prototype and volume production. This closely-knit engineering and scientific team is made up of the best engineering talent available today. Collective experience of the team includes work on every major missile program! Solar is continually exploring new scientific frontiers that will contribute to tomorrow's systems technology.

A new 16-page brochure describes in detail the men and the machines that make up Solar's advanced weapon systems capability. Write for it today and learn how Solar can step up your important program. Dept. G-123, Solar Aircraft Company, San Diego 12, Calif.

ENGINEERS WANTED! *Challenging projects, unlimited opportunities with Solar. Write today!*

SOLAR
AIRCRAFT COMPANY
SAN DIEGO
DES MOINES

For Systems Capabilities brochure mail to:

DEPT. G-123, SOLAR AIRCRAFT COMPANY
SAN DIEGO 12, CALIFORNIA

NAME_____

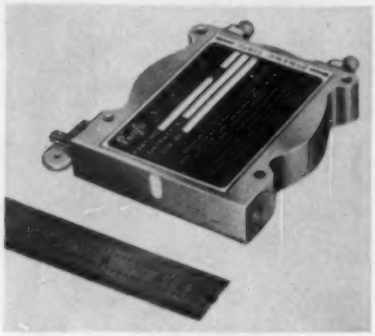
TITLE_____

FIRM_____

ADDRESS_____

CITY_____

NEW AVIATION PRODUCTS



Parachute Safety Sensor

Speed sensor provides one-second seat separation delay when airspeed is below 300 kt. and a three-second delay at higher airspeeds. This provides quick opening at low altitudes, when speed is normally below 300 kt., and a deceleration delay at high airspeeds.

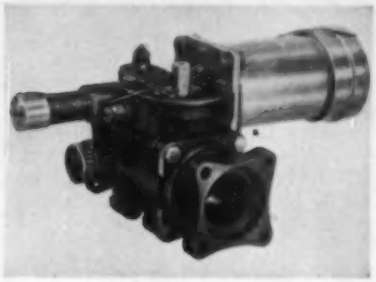
Safety device is connected to the aircraft pitot system. Prototype units of airspeed and safe altitude aneroid parachute delay are being tested at Wright Air Development Center.

Pacific Scientific Co., 6280 Chalet Drive, Los Angeles, Calif.

Missile Fuel Valve

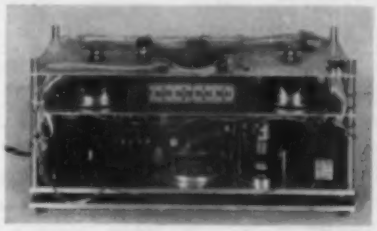
Ball valve is designed to handle hydrazine fuels in the temperature range of −35 to +120F at line pressure of 220 psi. Valve is applicable to aircraft and industrial uses as well as for liquid fueled rockets.

Helium powered actuator is effective



over a temperature range from −100 to +300F and at 250 psi. Closure time from full-open to full-closed is .030 sec. maximum. Dimensions are 10.125 in. maximum length, and 5.312 in. maximum width. Line size is 1.312 in.

Koehler Aircraft Products Co., 409 Leo St., Dayton, Ohio.



Sea-level Barometer

Direct-reading aneroid barometer indicates barometric pressure in inches of mercury. The instrument is intended for control towers and radio check points to provide altimeter setting.

Pressure-sensing elements are Melchior type aneroid capsules. Error caused by hysteresis does not exceed 0.001 in. over the instrument's range of from 21 to 31 in. Weight of the instrument is 15 lb.

Bulova Research and Development Laboratories, Woodside, N. Y.

Rocket Solid Propellant

Rocket solid propellant is designed for ejection seat propulsion, weather sounding rockets, spin rockets and cart-

HIGH TEMPERATURE CAPACITORS BY BENDIX

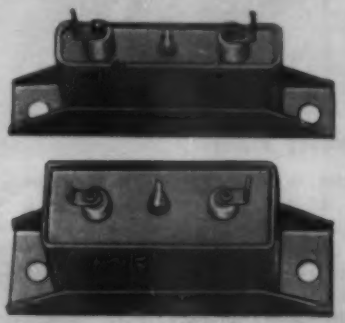
The *E*-315 capacitor offers proven stability of operation over the temperature range of −55° to +315° Centigrade* with no voltage derating and low capacitance variation. Of rugged hermetically sealed construction and nonstrategic materials, this capacitor is built for high altitude and severe environmental operation.

This nonpolarized capacitor is available in a variety of sizes in a capacity range of from 0.05 to 4.0 microfarads at 600 VDC. It is also available in higher voltage ratings. Performance data and operating characteristics are given in Technical Bulletin SL-61 which is supplied upon request.

*Confirmed by qualification test of 1000 hours at 100% rated voltage over ambient temperature range of −55° to +315° C.

Now Available in Production Quantity

E-315



DESIGN FEATURES

Temperature Range . . . −55° to +315°C. Capacitance . . . 0.05 to 4.0 uf at 600 VDC. Voltage Range . . . 600 V to 3000 V per section. No Voltage Derating, Low Capacitance and Power Factor Variation, Environmental Resistant, Hermetically Sealed, Rugged Construction, Nonstrategic Materials, Minimum Size and Weight, High Altitude Operation.

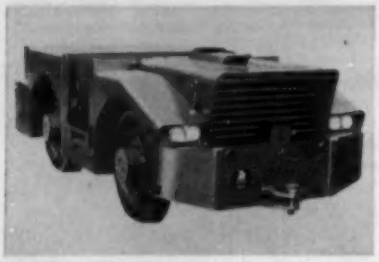
Canadian Affiliate: Aviation Electric Ltd., 200 Laurentien Blvd., Montreal 9, Quebec.
Export Sales and Service: Bendix International Division, 205 East 42nd St., New York 17, N.Y

Scintilla Division
Sidney, New York

Bendix AVIATION CORPORATION

ridge actuated devices. Propellant has a low temperature coefficient and is expected to withstand prolonged storage at elevated temperatures. Low temperature coefficient permits the use of lighter weight combustion chambers. The material now is in pilot plant production.

Propellex Chemical Division, Chromalloy Corp., P.O. Box 187, Edwardsville, Ill.



Jet Tow Tractors

Variation in components and specifications of a basic tow unit provides models with 22,500, 24,500 and 30,000 lb. drawbar pull.

The original Paymover T-300S has been modified and is now designated the T-350S with 35,000 lb. drawbar pull. Tractors have four-wheel-drive, front and/or coordinating steering, automatic transmission, torque-converter drive and are powered by International Harvester V-549 gasoline engines.

Frank G. Hough Co., Libertyville, Ill.

Frequency Meter

Meter, designed to test 400 cps. current, is intended for military field ground support application.

Instrument scale is from 397 to 403 cps. and accuracy is 0.1%. Meter requires no field calibration and is available in various models.

Alexandria Division, American Machine & Foundry Co., 1025 N. Royal St., Alexandria, Va.

Centrifugal Fuel Pump

Centrifugal fuel pumps for military and transport aircraft may be engine,

electric, hydraulic or turbine driven.

Modification of impeller and motor stack length provide a performance spread from 10 to 250 gpm. Pumps can be provided with custom mounts and meet military specification MIL-P-5238A.

Illustration is cut-away of modular a.c. pump.

Adel Precision Products, 10777 Vanowen St., Burbank, Calif.

Aerial Photo Printer

Photogrammetric printer corrects distortion in aerial photographic negatives taken at oblique angles. The printers will be used by the U. S. Department of Interior Geological Survey for aerial mapping.

Model 060 20 deg. printer permits an aircraft to take five pictures on a single pass over the target—to the front, rear, left and right at oblique angles, as well as directly downward. After correction, all photos will appear to be taken from overhead. Printer covers 9 x 9 in. negative format plus data area out to 10¼ x 10½ in. in the negative plane.

J. W. Fecker, Inc., 6592 Hamilton Ave., Pittsburgh 6, Pa.

ARMY MOBILITY AND FIREPOWER NEW VOUGHT STUDY AREA

Chance Vought has taken the volunteer's pace forward to work with the Army in an important mission . . . bringing new techniques to an ages-old defense area – the battlefield.

For 42 years a developer of high-performance aircraft and strategic missiles, this company has sharpened its focus on the needs of the new Army.

On its own initiative, Vought has engaged in new study and development programs to meet requirements of the Army of today and tomorrow. One new concept, still classified, was tested early in 1959 at the Army's Redstone Arsenal.

Design philosophies and an organization tailored to development of advanced aircraft and superior missiles are being adapted to the battlefield needs of total mobility and devastating firepower.

Vought's talents will continue to be directed toward fulfilling the requirements of our modern Army.

Advanced weapons is just one in the broad spectrum of Chance Vought fields of activity. Other areas include: design and production of high-performance aircraft, astronautics, electronics, anti-submarine warfare, range systems management, commercial process control systems.

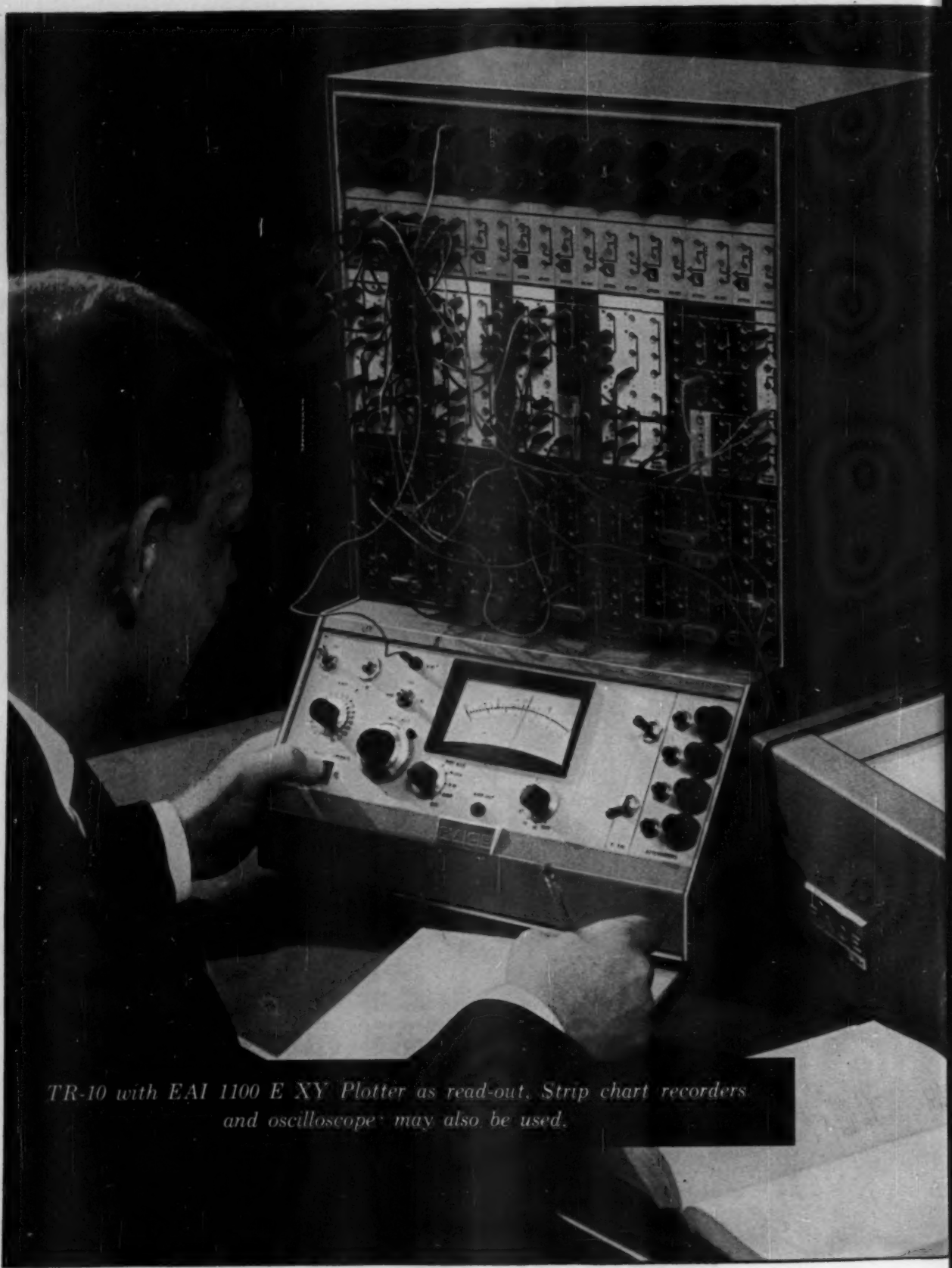
CHANCE VOUGHT
DALLAS, TEXAS

STRAC STRIKES !

They left in 30 minutes. With them went field kitchens, mortars, new battlefield missiles, barracks bags. All went aboard swift transport planes and headed for trouble 4,000 miles away. They arrived the same day, for this is a battle group of the Strategic Army Corps – world's most mobile army and our "defense on the double" against limited war. STRAC's kind of war has flared 18 times since V-J Day. STRAC's mission is to put out these "brushfires," or keep them from spreading. By quickening U. S. reaction to limited war, this crack Army corps helps lessen the prospect of global war.

ADVANCED WEAPONS · ASTRONAUTICS · ASW · ELECTRONICS · MISSILES AIRCRAFT · G · RANGE SYSTEMS

CHANCE VOUGHT
DALLAS, TEXAS



TR-10 with EAI 1100 E XY Plotter as read-out. Strip chart recorders and oscilloscope may also be used.

THE *FIRST* ALL TRANSISTORIZED ANALOG COMPUTER

—basic model less than $4000

PACE TR-10 Eliminates Drudgery
Gives New Insight Into Engineering Problems

New transistorized computer puts the advantages of analog computation within reach of every engineer. This compact unit, 15" x 16" by 24" high, is powered by 115 volts AC and can provide day-in day-out instant solution of your most vexing engineering problems. Even if you have never seen a computer before, you can learn to operate the TR-10 as easily as you learned to use a slide rule.

Gain New Insight to Complex Problems

Once the problem is set up on your computer, you simply turn a dial to feed in design parameters. The computer provides an instant by instant, dynamic picture of the effect of each change. You can study the inter-related effects of heat, pressure, flow, vibration, torque or any variable. And you can visually compare one with the other. You see problems in a new light – engineering data comes alive – insight into how new designs will work is obtained easier, faster. There's no need for recalculating every time you change a factor – simply turn the dial and see what effect it has on the solution.

Your "Personal Computer" for Higher Creativity

Because of its minimum size and extremely low price, the TR-10 can become your own personal analog computer. It helps to free you from routine drudgery. Permits you to gain first-hand experience with the power of analog techniques, and convert more of your time to *creative engineering.*

Test New Ideas or Designs

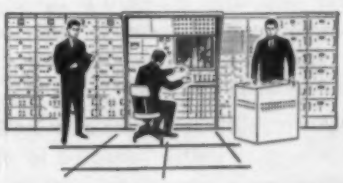
New ideas that were too costly to try before are now practical. Any possible combination of factors can be tried. You can design virtually to perfection and have a permanent, visual record of performance. All this can be done before building pilots or prototypes. As a result, "cut and try" expense is drastically reduced.

The same quality workmanship and design that has made Electronic Associates the world's leading producer of precision general purpose analog computers will be found in this new unit. Accuracy to ±.1 per cent. Modular construction allows you to select varying quantities of the following computing functions:

- Summation
- Integration
- Multiplication or Division
- Function generation
- Parameter adjustment
- Logical comparison

For complete engineering data, write for Bulletin TR-10-A.

EAI systems are serving engineers throughout the world. EAI maintains Computation Centers where PACE analog equipment is available on a rental basis. Write for details.



EAI ELECTRONIC ASSOCIATES, INC. ■ *Long Branch, New Jersey*

...NEWS IS HAPPENING AT NORTHROP

Now being produced and delivered to the U.S. Army Signal Corps, the Radioplane SD-1 gives greater battlefield surveillance flexibility to combat units than ever before. (This photo of terrain was actually taken from an SD-1 at 1,000 feet.)

RADIOPLANE PRODUCES FIRST COMBAT-READY SURVEILLANCE DRONE

Meeting tough Army Signal Corps requirements and being produced in operational quantities, the SD-1 is proved and ready to fly unmanned photo reconnaissance missions for tactical troops.

Highly mobile, the camera-carrying SD-1 may be zero-length launched in rough terrain from a camouflaged position. It is flown by remote control over enemy installations on surveillance missions without risking a pilot's life or man-carrying aircraft. Within minutes after the SD-1 returns from its mission, photographs are delivered to the requesting unit.

Other specialized sensory equipment may be carried by the SD-1 depending on particular mission requirements.

This Army-Radioplane achievement exemplifies Radioplane teamwork with all of the U.S. Armed Forces. Radioplane provides a complete drone family spanning medium speeds through supersonic performances.

RADIOPLANE

Van Nuys, California, and El Paso, Texas
A Division of
NORTHROP CORPORATION

Martin Expands Facilities to Win Business

By William H. Gregory

Baltimore, Md.—Martin Co. now has completed the bulk of its missile plant spending—an expansion program designed not only to help Martin win new business in the missile and electronic areas but also to expand the equity base of the company.

Foreseeing the growth in missiles and associated electronics equipment, Martin in 1955 began to build two plants expressly designed for such production and it decided to build the plants with its own money (AW June 17, 1957, p. 69). To date Martin has invested approximately $20 million each in the Denver plant where the Titan intercontinental ballistic missile is produced and the Orlando, Fla., plant that produces the Army's Lacrosse battlefield missile, Navy's Bullpup air-to-surface missile, and the Army's Missile Master anti-aircraft target information system.

Even though the government investment in tools and structures in the Denver plant alone is on the order of $100 million, dwarfing the company's own investment, effect of plant costs looms large in Martin's finances.

In 1955, Martin's undepreciated fixed assets were carried on the books at $11,559,000. This figure more than doubled the following year, climbed to $49 million in 1957 and reached $52,435,000 last year.

Financial Ratios

The financial ratios represented by this change make an interesting commentary on the implications of such changes under way to a greater or lesser degree throughout the industry. One of the common ratios used by credit analysts is fixed assets—plant and equipment in this case—to net worth, which shows how much money of its own—that is, stockholders investment or retained earnings for example—that the company itself has in the business.

In 1955, Martin's undepreciated fixed assets were 20% of its net worth. Last year they had risen to 73% of net worth.

By classical standards, any ratio higher than 75% for a large corporation is considered a cause for some concern. The rule of thumb is that the lower the investment in permanent facilities that might be hard to sell in an emergency, the better. Whether these credit rules of thumb apply to defense companies is another question, however.

Earl R. Uhlig, vice president and controller of Martin, agrees that there are problems for Martin and the industry as investment in facilities rises. "These are the dangers that we must face up to," he said. But if these are the rules of the game, Uhlig feels this is the way it must be played even though there may be dissatisfaction on such things as profit margins. The plant expansion program and the rise in Martin's missile and electronic backlog may not be cause and effect, but figures tell an interesting story:

Sales (000 Omitted)

Year	Missile Electronics	Aircraft	Total
1953	$30,978	$173,519	$208,007
1955	52,638	218,426	271,862
1957	245,796	177,054	423,925
1958	200,683	154,211	355,533

(1958 figures are for nine months ending Sept. 30. Commercial sales omitted all years.)

Backlog (000 Omitted)

1953	55,520	498,170	554,447
1955	313,464	352,571	666,436
1957	496,978	297,900	795,054
1958	457,889	203,464	661,678

(1958 figures are nine months.)

Some of the stock financial criteria don't mean much to a contractor like Martin, almost 100% in the military business. Current ratio, for example. This normally is the No. 1 rule of thumb, the measure of a company's liquidity, its ability to pay its bills. Though industries vary, a ratio of $2 of readily available assets—cash, receivables, marketable inventory—to every $1 of currently payable liabilities is regarded as sound.

Uhlig says the current ratio to a company such as Martin is of secondary importance as long as it is at least 1.1 to 1. Cash is readily available in emergency to a big military contractor either right at the plant from the military representative or from a nearby military installation.

For companies like Douglas or Boeing with big commercial jet transports, current ratio is much more significant. Uhlig for his part made it clear how happy he is Martin is not in the commercial transport race, with its heavy research and development write-downs.

Cautious Line

Uhlig walked a cautious line in discussing the pros and cons of military contracting. There are dangers, he pointed out, in expanding plant capacity as Martin has, expecially when the increased profit margins that were supposed to accrue to companies which used their own funds for such work have shown no sign of materializing.

At the same time he pointed out that Martin (or any other aviation company) is unlikely to balk over a percentage point or two of profit if that is the way the contract is offered. Future sales volume is the primary concern. If volume remains high for Martin, the cash is there to cover depreciation of the plant program and to maintain the company's technological

Avionic Fund Raising

A spate of common stock offerings by avionic companies hit the market within the last two weeks, probably triggered by the "glamour" status that has sent prices soaring for electronics shares.

At least six companies were involved in such offerings: Telecomputing Corp., Microwave Associates, Electronic Engineering Co. of California, Packard-Bell, Polarad Electronics Corp., and New Hampshire Ball Bearings, Inc. Such offerings by single companies have not been uncommon in the last year, but this is the first instance of real bunching.

Some of them show a need for working capital. Others appear to be taking advantage of the rising prices to retire interest-bearing debt. In some cases major stockholders who are founders or officers are selling portions of their interest.

An allied example is Ryan Aeronautical Corp., which has gained, as has Martin Co., a status in the market as an electronics company. Ryan has just made an offering of 330,000 shares, 55,000 of them for the account of T. Claude Ryan, founder of the company. These are shares of the new stock, which will be split 2½ to 1 next week.

More such offerings are likely and may reflect the problems of some electronics companies which have accepted low-profit research and development contracts on the uncertain prospect of gaining a long-run production contract (AW Mar. 9, p. 213).

HERE'S HOW BELL

is helping make the American public aware of the objectives of today's NEW U. S. Army in its continuing program of modernization . . a program vital to our national defense and security in an age of new weapons and new concepts of warfare.

**One of a series of ads currently appearing in such opinion-making publications as Fortune, Business Week and U.S. News & World Report.*

AERIAL COMMAND POST *for the* **NEW U.S. ARMY**

and there's a BELL in the Picture

In warfare of the future, the concentration of forces in small areas would invite annihilation by "area weapons." Thus, the wide dispersal of combat forces makes the task of *precise* direction and coordination more urgent than ever before. In fact, it would be hard to overstate the field commander's necessity for having rapid transportation to cover wide areas of the battlefield. Such transportation must be by air. Army Aviation gives today's new Pentomic Army this battlefield mobility — in command, liaison and communications. Bell helicopters, with their unequalled ability to land or take off from small unimproved areas — their ease of maintenance, requiring only simple ground facilities — play a vital part in the Army's "intimate coordination of effort." They help the new Army achieve the *mobility* that can spell the difference between victory or defeat.

FORT WORTH, TEXAS
SUBSIDIARY OF
BELL AIRCRAFT CORPORATION

BELL
HELICOPTER CORP.

*

FORT WORTH, TEXAS | SUBSIDIARY OF BELL AIRCRAFT CORPORATION

BELL
HELICOPTER CORP.

Profit Margin Comparison

	PROFIT PERCENTAGE OF SALES				PROFIT PERCENTAGE OF NET WORTH PLUS INTEREST-BEARING DEBT			
	1955	1954	1953	1952	1955	1954	1953	1952
Bell	5.9%	7.0%	7.3%	6.2%	31.4%	30.7%	28.8%	17.3%
Boeing	7.3	7.4	6.4	6.7	51.5	70.1	71.6	73.7
Chance Vought		9.4				60.7		
Convair			4.2	4.6			16.1	17.5
Douglas	6.7	8.7	7.0	6.4	43.5	66.2	46.1	23.9
Fairchild	5.8	6.2	8.3	7.4	22.1	20.9	33.4	20.4
Grumman	10.0	10.1	10.0	8.3	45.1	57.1	66.5	55.8
Lockheed	5.3	6.3	5.9	4.0	27.8	51.6	46.8	16.2
McDonnell	7.4	6.6	6.6	7.5	41.9	27.0	29.5	22.3
Martin	8.9	7.8	7.3	4.0	42.5	44.7	38.7	15.3
North American	8.3	8.1	6.3	6.4	57.7	50.3	31.9	18.7
Northrop	9.1	5.2	3.8		101.6	32.5	27.1	
Republic	5.6	5.8	6.7	6.6	55.6	39.0	75.4	123.1
Average	7.1	7.5	6.5	6.1	45.8	51.2	42.1	28.9
Curtiss-Wright	14.3	8.3	8.1	6.4	46.1	28.0	28.1	17.3
United Aircraft	9.6	8.2	8.5	7.7	40.2	35.7	42.5	31.4
Average	11.6	8.2	8.4	7.2	43.1	32.0	36.2	25.1
DuPont*	31.9	29.8	32.0	32.1	50.4	42.6	50.5	49.4
General Electric	11.9	13.2	15.2	15.8	34.5	38.2	50.9	47.6
General Motors	13.2	16.7	16.5	19.7	55.8	45.2	55.4	54.6
Average	20.2	17.5	18.0	20.5	51.5	43.4	53.5	52.1

* Exclusive of investment in and dividends from General Motors

capabilities even though profit margins might be at a disappointing level.

Martin last year increased its earnings about 20% while its sales rose only about 15% despite an increase in less profitable research and development contracts. Stress on cost cutting played a part here though the company finds missile contracts are slightly more profitable than aircraft.

Pretax profit margins on missile contracts now are running about 6-7%. Uhlig would like to see a somewhat higher figure than that but sees little hope in them reaching the maximum 15% allowed by law.

Sales Volume

Uhlig expects Martin's missile and electronics sales volume to exceed the 72% proportion of last year as the P6M Seammaster phases out. However, Martin is not withdrawing from the aircraft market. How the Dyna-Soar might be classed in the Martin breakdown—missile or airplane—is still a question, Uhlig said.

Martin's sales and earnings are forecast to increase this year, earnings possibly to $5 a share. The company's net worth also should continue to grow, partly aided by increased cash throw off from depreciation which will begin in earnest this year under fast amortization certificates.

The company sold $20 million of 5¼% debentures last year. Primarily this was to build Martin's working capital position which dropped from $37 million in 1956 to $15 million in 1957. Here again Uhlig does not believe in over-emphasizing working capital. The main consideration for a military contractor is to have enough money to run the business plus the resources to convince a potential customer the company is financially able to carry the new business.

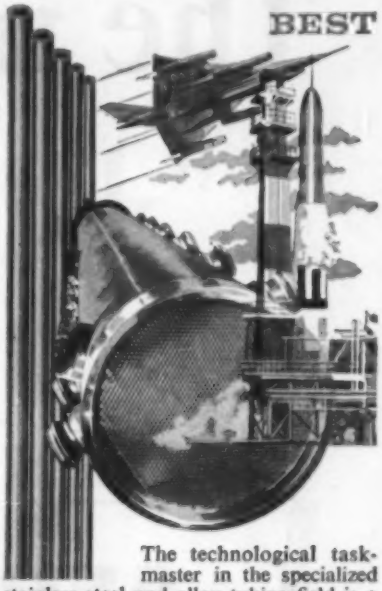
Martin also has a line of bank credit totaling $50 million, with $22,500,000 borrowed against it at year end.

One added burden on working capital is the necessity for defense companies to carry more government receivables because of reductions made in progress payments and cost reimbursement two years ago. Uhlig said that in effect the government by this step turned over a share of its debt management to industry to handle. In this light, Uhlig has been watching the problems the government has had in refinancing its debt in the bond market; at the moment he did not appear unduly concerned at the implications of this for the industry.

At the same time it sold the debentures, Martin also attached 10 warrants to each $1,000 certificate, each warrant entitling the holder to purchase one share of Martin stock at $40 a share prior to Nov. 1, 1963, and $45 a share until 1968. Though Martin's stock has sold at over $60 a share in recent weeks, none of the warrants has been converted. The company has author-

when the HEAT's on

YOU CAN DEPEND ON TMI TUBING TO BE AT ITS PERFORMANCE BEST



The technological taskmaster in the specialized stainless steel and alloy tubing field is a dictator of the nth magnitude! He, too, has his heart and his eye set on keeping American pioneering accomplishments in metalworking at its performance best! With this common objective, TMI is his inflexible servant . . . around the clock . . . in every department from research to production line . . . with every skilled worker and dedicated supervisor pounding away at the combination of quality and accuracy regardless of how "tough" the specification formulae!

When your inquiry comes to TMI, it is destined to be in the company of the most progressive names in aviation, in nuclear applications, instrumentation and a wide range of chemical development.

The standard range of quality production at TMI—.050" to 1.250" O.D. with tolerances as close as .0005" when required.

TUBE METHODS INC.

METALLURGISTS • ENGINEERS • MANUFACTURERS

BRIDGEPORT (Montgomery County), PA.

Announcing...

The most important in aircraft oils

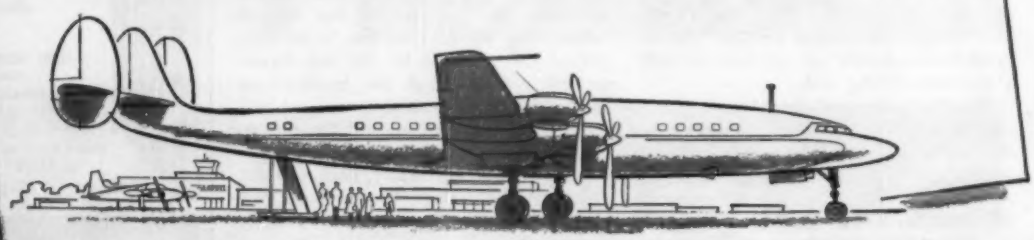
PREMIUM

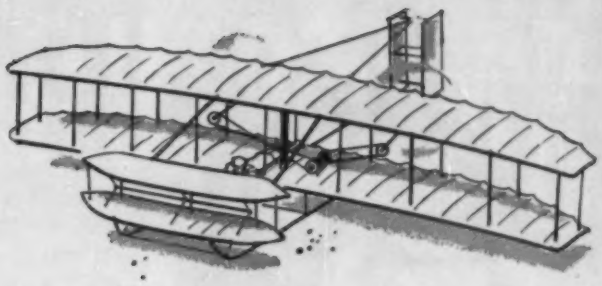
AEROSHELL OIL W

AVAILABLE IN 2 VISCOSITY GRADES:

80 GRADE FOR SMALL ENGINES WHERE STRAIGHT MINERAL OIL GRADE 55, 65 OR 80 IS NORMALLY RECOMMENDED

100 GRADE FOR LARGE ENGINES WHERE STRAIGHT MINERAL OIL GRADE 100 OR 120 IS NORMALLY RECOMMENDED





advance since "Kitty Hawk"

It's the world's first non-ash, fully compounded dispersant aircraft oil to be marketed for both large and small piston-engine aircraft. This oil has *multi-viscosity* characteristics which reduce the need for seasonal grade changes.

Prior to the development of AeroShell® Oil W, all fully compounded aircraft oils had these two disadvantages—(1) pre-ignition and (2) spark-plug fouling—that were caused by the formation of ash deposits in the combustion chamber.

Now—for the first time, a completely *non-ash*, fully compounded aircraft oil is available for all piston-engine aircraft.

Performance of AeroShell Oil W is superior to that obtained with the best straight mineral oils. AeroShell Oil W has been extensively flight-tested in a wide range of engines and the results show—

1 Significant reduction in oil consumption.

2 Reduced parts wear... increased engine life.

3 Cleaner engines—practically eliminates oil screen and filter deposits.

4 Easier starting and faster warm-up.

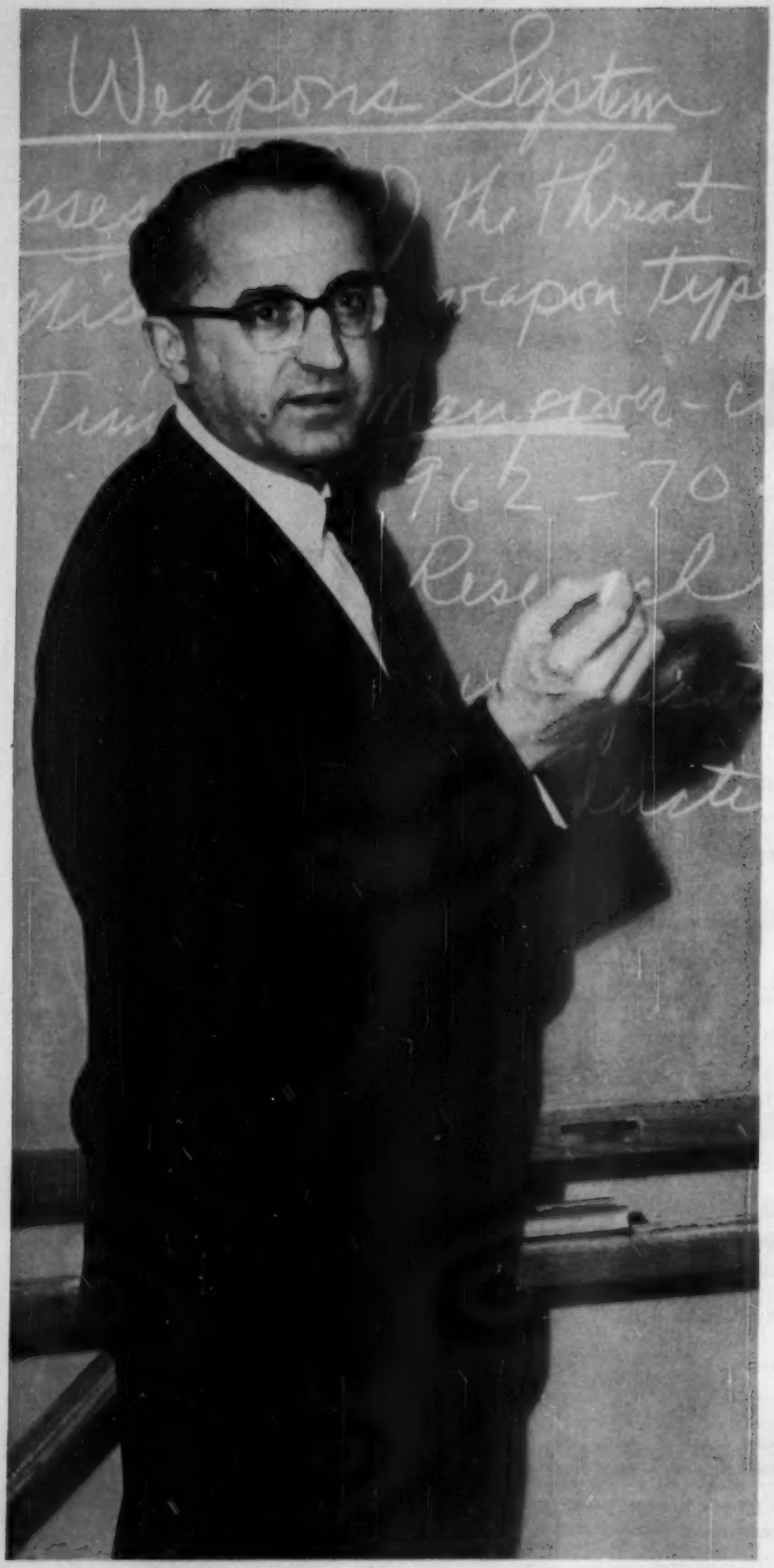
Already four airlines have converted their entire fleet operation to the use of AeroShell Oil W.

We will be glad to give you complete information on AeroShell Oil W—the most important aircraft oil advance in 56 years.

SHELL OIL COMPANY

50 WEST 50th STREET, NEW YORK 20, NEW YORK
100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA

SHELL



I READ BUSINESS WEEK

"Today, science and management are inseparable worlds. In the highly technologically based industries, we must use both tools. That is why we rank Business Week with our best scientific sources."

DR. CLEDO BRUNETTI
Vice-President &
General Manager
Grand Central Rocket Co.
Redlands, California

A McGraw-Hill Magazine

YOU ADVERTISE IN BUSINESS WEEK WHEN YOU WANT TO INFLUENCE MANAGEMENT MEN

ized issuance of 200,000 shares for such conversion and this would add about $8,000,000 to net worth.

Net worth as a basis for computing profit margin has been involved in the controversy between the aviation industry and the Renegotiation Board over redeterminations. The industry points to its low margin on sales—reported by the First National City Bank of New York for 41 companies as dropping from 3% in 1957 to 2.6% in 1958 while the average for all manufacturers fell from 5.9 to 5.2%.

The Board considers margin on net worth a more valid criterion. For the same companies listed by First National City, margin on net worth dropped from 20% in 1957 to 14.5% last year compared with a drop from 12.9 to 9.8% for manufacturers generally.

Uhlig believes there is merit in the net worth margin. However, he believes all interest-paying debt should be added to net worth before making renegotiation decisions in order to reflect fairly the cost of capital and the efforts by the industry to broaden its equity base. Comparisons by Uhlig for years on which renegotiation is in progress are in accompanying table, p. 99.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

Northwest Airlines, Inc., St. Paul, Minn., purchase, storage, maintenance, inspection and receipt of group B parts for the CRAF program, (PR EM-9-S-6241, complete), $90,539.

Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., 2,660 ea., wheel assemblies, 49 x 17, installations for KC-135A aircraft; 2,406 ea., brake assemblies (for 49 x 17 wheel), installations for KC-135A aircraft, (PR's EA-9-03B-4389 and EA-9-03B-4480), $3,957,578.

Allen B. DuMont Laboratories, Inc., Clifton, N. J., 72 ea., LA-21 master controls, Aerno 74-779, universal camera control system and components thereof as follows: 7a ea., bracket assemblies; 72 ea., bracket-INNER-ALUM; 142 ea., power supplies for use on RF-101 aircraft, (PR's MO-9-6710-1929, MO-9-6760-2168 and MO-9-6760-2191), $945,357.

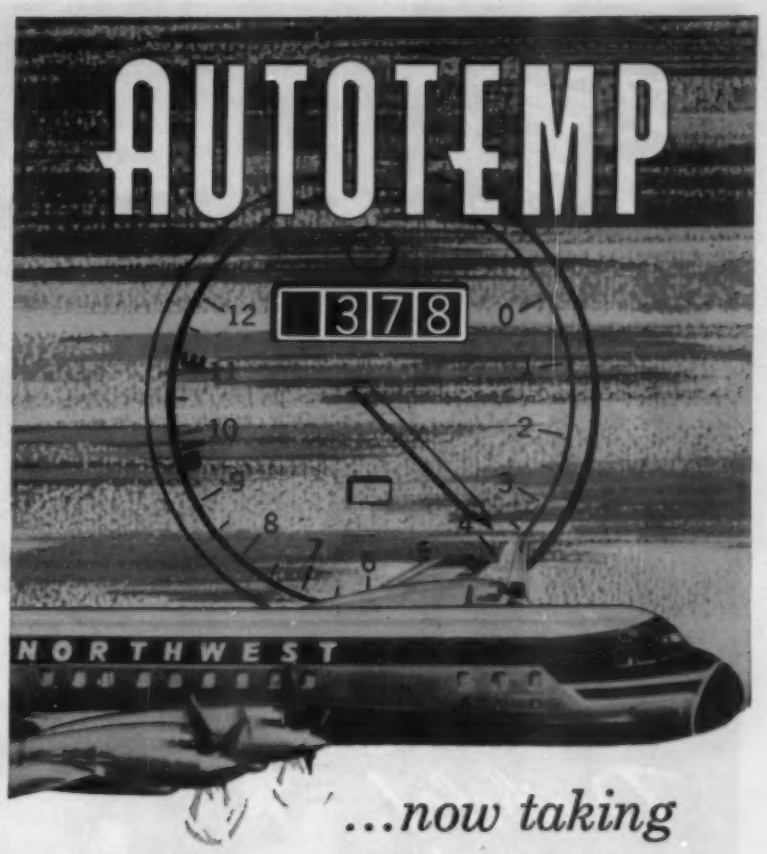
Connecticut Telephone & Electric Corporation of Meriden, Meriden, Conn., 862 ea., amplifiers, AM-843A/AIC-10A for support of replenishment spares, IFB 33-600-59-58 (PR MD-9-16A-35123), $55,917.

National Company, Inc., Malden, Mass., frequency standard, missile borne, synthesizer to be employed for missile application, for use in service test program, (PR 07072), $250,000.

Southwest Research Institute, San Antonio, Texas, additional facilities for missile lubrication research and test method development, (PR 08337), $37,000.

Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., 392 ea., wheel assemblies, main, 49 x 17, Aerno 41-7006, replenishment spares for KC-135A aircraft, (PR 00-9-03B-2802), $303,047; 61a ea., main wheel assemblies and data for replacement spares in F-104A, B, C and D aircraft, (PR 00-9-1630-3255), $100,000.

The Seigler Corp., Hallamore Electronics Co., Anaheim, Calif., four ea., service test quantity of generators, 60 kva., variable speed, constant frequency, IFB 33-600-59-141(PR PS-9-03C-4256), $94,500.



...now taking
Lockheed ELECTRA'S
temperature...to 1°C.

High accuracy, and easiest *needle pointer plus digital in-line counter readout,* are the principal service features of the BH183 AUTOTEMP® jet engine temperature indicator.

AUTOTEMP is designed and produced by the makers of the JETCAL Analyzer®, the only jet engine tester used throughout the world.

The AUTOTEMP is a completely new instrument...a continuous null balance 144-inch slidewire potentiometer combined with a linearizing analog-to-digital converter. Its accuracy is the simple attribute or phenomenon of its novel and basic slidewire potentiometer!

Completely self-contained...transistorized, miniaturized, hermetically sealed, servo-driven...the AUTOTEMP's 3"-diameter case includes a Zener reference, power supply, amplifier, servo motor, cold junction compensation and the 144-inch slidewire and punched tape to linearize thermocouple e.m.f. for exact, counter-type digital readout. The needle pointer indicates in 50°C increments over the 0 to 1200°C full range of the unit.

Full information is contained in our Bulletin BH183 available for the asking!

b&h B & H INSTRUMENT CO., INC.
3479 West Vickery Blvd. • Fort Worth 7, Texas

Sales-Engineering Offices: COMPTON, CAL., VALLEY STREAM, L. I., N. Y., DAYTON, OHIO, TORONTO, ONT. *(George Kelk Ltd.)*, MITCHAM, SURREY, ENGLAND *(Bryans Aeroquipment Ltd.)*

For moderate, economical silencing of jet-powered commercial and military aircraft . . .

NEW KOPPERS PORTABLE RUN-UP SILENCER TAKES THE PUNCH OUT OF JET NOISE

Now, airports, air bases and manufacturers of jet engines or airframes can run up jet engines without complaint or creating physical hazards. The Koppers Portable Run-Up Silencer reduces noise by 25 to 30 decibels—lessens the risk of hearing damage to operating personnel, improves community relations and reduces speech interference.

The new portable silencer inhibits the generation of jet engine noise, rather than suppressing it after the noise has reached full intensity. The unit is light in weight and completely portable—no direct attachment to the aircraft or engine is necessary. Look to Koppers with its longest experience in the industry to solve your aviation noise control problems.

Write for Koppers new sound control brochure today. KOPPERS COMPANY, INC., Sound Control Department, 3503 Scott Street, Baltimore 3, Maryland.

Official United States Navy Photographs

KOPPERS

SOUND CONTROL

Engineered Products Sold with *Service*

Competition Tightens for Small Business

Santa Monica—Warnings that competition will get tougher, requirements more stringent and costs will be watched more closely, were sounded for small business operators during the Small Defense Industries Conference here.

Forecast of the future was best summed up by Lt. Gen. Clarence S. Irvine, retired USAF Deputy Chief of Staff for Materiel, who said that "no one intends to award contracts on a guardian angel basis."

The forecast was echoed by several speakers at the one-day conference which included sessions on the role of small business under the weapon system concept, pools and joint ventures, renegotiation, proprietary rights and military cost principles. The conference was jointly sponsored by Strategic Industries Assn. and the Graduate School of Business Administration, University Extension, University of California at Los Angeles.

Business Role

Speaking on the role of small business under the weapon system concept, specific warnings concerning the future of small business were given by Barry J. Shillito, director of sales, Airborne Systems Group, Hughes Aircraft Co. Among his predictions:

- **Number of small businesses** participating in the defense effort will shrink considerably in the next few years. He also said he expects there will be fewer prime contractors in the defense complex in the next few years.
- **Several fields** are overcrowded.
- **Second-source procurement** will be out, when one source proves to be reliable, operating at a low cost, or is outstanding in its performance under the subcontract.
- **Small business** will have to live with the weapon system concept instead of trying to fight it.

Citing reasons why there will be fewer contractors in the over-all defense complex, Shillito listed these reasons—there will be fewer items produced; over-all there will be a lower labor force required; and the technical dollar cost of items will increase considerably.

Shillito said that at present 16% of all the money spent for defense is going to small business. He pointed that in the period of 1954, to 1958, procurement at Hughes increased threefold, while at the same time the number of suppliers decreased by 50%. However, he pointed out, the ratio of dollars spent with small business stayed the same as before.

He stressed that there will be no room for marginal contractors in highly competitive fields and outlined a number of problems which small businessmen now face. Leading these was advance planning, in which he pointed out that small business owners and operators must realize the relationship between their product and the end item.

Planning should be accomplished to best advance the company's product or product line, in relationship to the end item for which it is being produced. In addition, he said, the company management must look ahead toward the requirements for future systems to which their company can contribute services, goods, or products.

Another point he made was that to succeed these days, a small company must specialize, to put itself in the position where it can do something better than any of its competitors, regardless of what this is.

He emphasized that small businessmen should, where possible, move away from fields which are overcrowded. Elaborating on this, Shillito recommended diversification as a necessary step in sound management, planning for the company's future line of products.

In another talk, Gen. Irvine outlined the role which small business had played in defense procurement during his time in the service. He also emphasized the changing picture in the past few years under the weapons system concept for the defense small business defense contractor.

Gen. Irvine pointed out the differences between the weapon system concept and the former method, in which Air Force most often dealt directly with a supplier or small business firm, bought its product, and then gave it a prime or subcontractor to be included in the airplane or other weapon, as government furnished equipment (GFE).

Gen. Irvine cited the fact that before World War II, 25% of the weapons the Air Force bought were built under subcontract. During World War II, this rose to 40%. For the upcoming WS-110A, North American's B-70 Valkyrie bomber, he noted, this has risen to 70%.

Speaking at the same session, Ted C. Coleman, president of Coleman Engineering Co., asked that the larger prime contractors and first tier subcontractors judge each small business and their product on their merits as individual firms and products, rather than "lumping us all in one category."

System Bidding

Coleman said that it was his feeling, along with many others, that quite frequently when a small concern is bidding in a subsystem or a system, the major contractors have a tendency to "pick our brains" and incorporate the results into their own proposal.

Coleman noted that the costs of developing proposals and making a sales effort as a part of the weapon system or of a product being urged for incorporation in a weapon system is extremely high for small companies. However, he noted that an aggressive sales approach is an absolute requirement for small business seeking a role in the weapons system design and production.

He also urged other small concerns

Increased Missile Funding

Santa Monica, Calif.—Congress probably will increase funding for missile production above the figure that Administration has recommended, Lt. Gen. Clarence S. Irvine (USAF, ret.), said here at the Strategic Industries Assn. meeting. In other observations, he added:

- **Atlas and Thor missiles have considerably exceeded expectations in their speed and success.**
- **Subcontractor setup on the North American B-70 Mach 3 bomber was influenced by several factors. Among these was stabilizing labor force at various plants by subcontracting major portions and assemblies of the airplane from one plant to another. He cited the example of Boeing Airplane Co. manufacturing the wings. This way, he explained, workers were not laid off at Boeing, only to move to North American to work on the aircraft, but instead were able to do the work by remaining at Seattle.**
- **Concerning the taxes on the possessory interest situation in Los Angeles, Gen. Irvine said he believes the basic premises are invalid. In this, Los Angeles County is seeking to levy property taxes on federally-owned material in a contractor's plant, which the contractor is fabricating into a product or will incorporate into a product which the contractor will sell and make a profit thereby. Gen. Irvine indicated it is a happenstance that the plants are located in a particular area, that the property attempting to be taxed is owned by all American taxpayers and the tax bill which would be levied would not be applicable to all U. S. taxpayers. Similarly, the benefits from the tax monies would only accrue to those living in Los Angeles County, although the material actually is owned by all U. S. taxpayers.**

to develop certain specialties in which they can become outstanding.

During questioning from the floor, W. B. Stults, staff director for the Senate Select Committee for Small Business, observed that small companies which had banded together in pools to make proposals on systems had received no contracts since World War II. Answering this statement, Gen. Irvine said that during his service, procurement officers had not been "for or against" such a grouping. He indicated that he felt there is a need for such groups, but that Defense Department procurement personnel had one primary aim, that of getting the best weapon system available for the money.

Moderating the panel on role of small business under the weapon system concept was Dr. George A. Steiner, director, Division of Research, Graduate School of Business Administration at UCLA.

Leading participant in a discussion on renegotiation was Thomas Coggeshall, chairman of the Renegotiation Board, Washington, D. C. Speaking for Strategic Industries Assn. was Gordon W. Jenkins, president, Anachrome Corp., a director of SIA and chairman of the association's renegotiation task committee. Moderator was Dr. Fred Weston, professor of finance at UCLA.

Profit Margin

Jenkins outlined the situation which SIA believes exists vis-a-vis renegotiation and small business. He pointed out that Department of Defense contracts allow a contractor greater margin of profit on in-house work than they do on items and equipment which are subcontracted. This, he said, tends to make the larger prime contractors do work in-house which they otherwise might subcontract.

He also indicated that small businesses face renegotiation according to total sales subject to renegotiation according to the law.

Coggeshall declared that, on the other hand there were a number of aspects of the renegotiation law which were considerably more liberal than those of standard Air Materiel Command procurement contracts.

Coggeshall pointed out that when renegotiation reports are filed, the companies are allowed many more deductions on costs than they are with the regular production contracts, thereby lowering the amount subject to renegotiation.

He also read excerpts from a letter written to a member of Congress, in which the Renegotiation Board listed the feelings and stands on renegotiation, in relation to small business. In this, it was noted that favorable consideration was given in Renegotiation Board proceedings to those major contractors who have followed or exceeded requirements of the law in the amount of subcontract work which they have farmed out to small business.

Coggeshall was asked if he believed that renegotiation actually produced inflated costs in various contracts. He replied he thought this definitely was not so, and that inflated costs would be recognized by procurement officers, resulting in having the firm put on blacklist.

In the session on proprietary rights, moderated by Harold Petrowitz, acting assistant professor of business law at UCLA, participants were Stults and David G. Saunders, general counsel for SIA.

Stults presentation started with an admittedly "flagrant" example of the government feelings concerning proprietary rights. In this, he pointed out that there was a proprietary item which was costing the government more than $250 each, a generator part, under the sole source contract. However, he said, when the part was put out for advertised bids, the price came down to $2.72.

Stults continued that it has been urged by congressmen that everything be procured under advertising bidding, as a vote-getting means. He added, however, that he contrasted this with what SIA believes is fair, a protection of proprietary rights of items developed by companies, things which the companies themselves invented, with their own company funds.

He noted another situation which frequently exists. Under this, a company comes to the service buyer with an idea, sells the idea, then is given government funds to adapt the product, which may already exist in commercial form or an experimental model, to conform to military specifications or be changed slightly for incorporation into a particular military system. In this condition, Stults said, the item actually is a half-and-half proposition, half the company's and half the military's, which now is buying the item.

Big Business' Share

From statistics presented to the committee, Stults said he realized the problems faced by small businessmen. Testimony before the senators indicated, Stults said, that 84% of the defense dollar went to big business firms. In addition, he said, 86% of the first tier subcontracts also went to big business firms; in effect, another 86% of this last 16% of defense dollars also was taken off the top by large companies.

Speaking for SIA, Saunders declared that while conversations with Department of Defense and service secretariat level officials in Washington indicated that these persons knew and recognized the small business problem, including proprietary rights, and that at the lower

FLIGHT DATA and CONTROL ENGINEERS

Cross new frontiers in system electronics at The Garrett Corporation.

High-level assignments in the design and development of system electronics are available for engineers in the following specialties:

1. ELECTRONIC AND FLIGHT DATA SYSTEMS AND CONTROLS A wide choice of opportunities exists for creative R & D engineers having specialized experience with control devices such as: transducers, flight data computers, Mach sensors, servo-mechanisms, circuit and analog computer designs utilizing transistors, magamps and vacuum tubes.

2. SERVO-MECHANISMS AND ELECTRO-MAGNETICS Requires engineers with experience or academic training in the advanced design, development and application of magamp inductors and transformers.

3. FLIGHT INSTRUMENTS AND TRANSDUCERS

1) **DESIGN ANALYSIS** Requires engineers capable of performance analysis throughout preliminary design with ability to prepare and coordinate related proposals.

2) **DEVELOPMENT** Requires engineers skilled with the analysis and synthesis of dynamic systems including design of miniature mechanisms in which low friction freedom from vibration effects and compensation of thermo expansion are important.

4. PROPOSAL AND QUALTEST ENGINEER For specification review, proposal and qualtest analysis and report writing assignments. Three years electronic, electrical or mechanical experience required.

Forward resume to:
Mr. G. D. Bradley

THE GARRETT CORPORATION
9851 S. Sepulveda Blvd.
Los Angeles 45, Calif.

DIVISIONS:
AiResearch Manufacturing—Los Angeles
AiResearch Manufacturing—Phoenix
AiResearch Industrial
Air Cruisers • Airsupply
Aero Engineering
AiResearch Aviation Service

LIGHTWEIGHT airborne electronic cooling package

PERFORMANCE CHARACTERISTICS—
Heat Rejection: 200 watts... Inlet Gas Temperature to Component Housing: 130°F.... Weight of Fan, Evaporator and Controls: 1.25 lb.

Spans the gap between direct ambient cooling and closed cycle systems

• *This AiResearch open-cycle cooling unit* is designed for environmental conditioning of electronic and electromechanical equipment in problems of low total heat dissipation aboard aircraft and missiles.

Much lighter and less complex in operation than closed cycle systems, this compact package is recommended when required total heat dissipation is low... large heat loads for short periods of time, or small heat loads for long periods of time. It also replaces direct ambient cooling systems when ambient sink is not low enough or not easily available.

Ammonia in this expendable evaporative system cools sulfur hexafluoride (SF_6) which passes over the hot electronic components. The SF_6 then recirculates for cooling, and the ammonia is dumped overboard.

Applications of this system include: inertial guidance system cooling, missile transient cooling, and spot cooling where ambient sink is not available.

AiResearch has designed and manufactured cooling systems of all types ...direct ambient, closed and open-cycle systems handling all magnitudes of cooling loads and utilizing various working fluids. We invite you to send us details of your problem.

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

Systems, Packages and Components for: AIRCRAFT, MISSILE, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

Engineers:
Here are sound reasons why it pays to specify
USS Shelby Seamless Mechanical Tubing

USS Shelby Seamless Steel Mechanical Tubing offers you extraordinary freedom of design in a wide range of products from bushings to hydraulically operated telescoping booms. And, Shelby Seamless Tubing helps cut processing costs, because it eliminates drilling operations; enables you to replace drills with simple, less expensive boring tools, and it reduces tool wear and tool changes; and, more important, more uniform parts can be turned out by the hundreds or thousands.

Where Shelby Seamless Tubing is used as a load-carrying member or part, it exhibits a number of structural advantages over other forms. *Here are a few:* it gives you a superior cross section when a part is designed to withstand equal loading in any direction; it resists bending stresses equally in all directions; it is able to absorb and localize shock; and in torsion, it provides better material distribution, and for a given weight, can withstand more load than other sections.

And, of course, the name Shelby is backed by the world's largest and most experienced manufacturer of seamless tubing—National Tube! The production of Shelby Seamless Tubing, from ore to finished product, is entirely controlled by one organization. There is no divided responsibility. Every foot, every length, is made under the careful supervision of skilled men with years of tubemaking experience. For more than 60 years, Shelby Seamless Tubing has been first with men who want the best in mechanical tubing.

You'll find Shelby Seamless Tubing available at select Shelby Distributors throughout the country. These distributors are strategically located and expertly trained in solving all types of tubing problems. Here, you can choose from a complete range of sizes and stocks. If you'd like to find out how Shelby Seamless Tubing can be most effectively applied to your designs, contact your nearest Shelby Distributor . . . *soon!*

USS and Shelby are registered trademarks

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Supply Division • United States Steel Export Company, New York

echelon where actual procurement occurs, the tendency is for officers to "grab everything for the Star Spangled Banner."

A condition which exists widely and is of concern to small business concerns was aired at the proprietary rights session. This situation, according to Saunders and various persons speaking from the floor, arises when a small businessman goes into a military procurement office to sell his item, and the military officer demands complete drawings and specifications of the idea, as does the prime contractor.

Then, the small businessmen claim, the prime contractor frequently incorporates the idea into his proposal as his own idea. The military procurement officer takes the small businessman's item and advertises for bids on the item, using the small businessman's own plans and specifications as the basis on which bids are to be submitted.

A vital need, according to SIA, is protection for the small businessman and his proprietary items which he has developed with his own funds, but still must deal with a military officer or large prime contractor to sell his product.

United Front

Saunders said that an absolute necessity for small businessmen will be for them to unite in their actions to protect their proprietary interests through SIA, to present a united front both in Washington and at the local level. Although he said the Washington-level officials seem to understand the situation, the local procurement officers are not as clearly informed.

Stults cited an example wherein recently a major company displayed an item publicly which it claimed would give it an advantage in commercial television. However, he said, this item had been developed with military research and development funds. He noted that the company is claiming the commercial rights to this item.

When a question was raised concerning the matter of using drawings and specifications of proprietary items, an instance was proposed in which the developer was unable to meet schedule and quality in production of his item. The answer to this would obviously be, Saunders said, that he should be financially rewarded for his proprietary interest, either by allowing other subcontractors to sublicense or produce the item on a royalty basis, since the item is definitely required in the national interest before it is placed in production with other firms.

Concerning revision of regulations to protect proprietary rights, a Navy representative declared he actually felt the regulations as they presently are promulgated are all right. He allowed,

TO ENGINEERS

Who desire to Conclude fall School plans now

Rohr will be in or near your city soon.

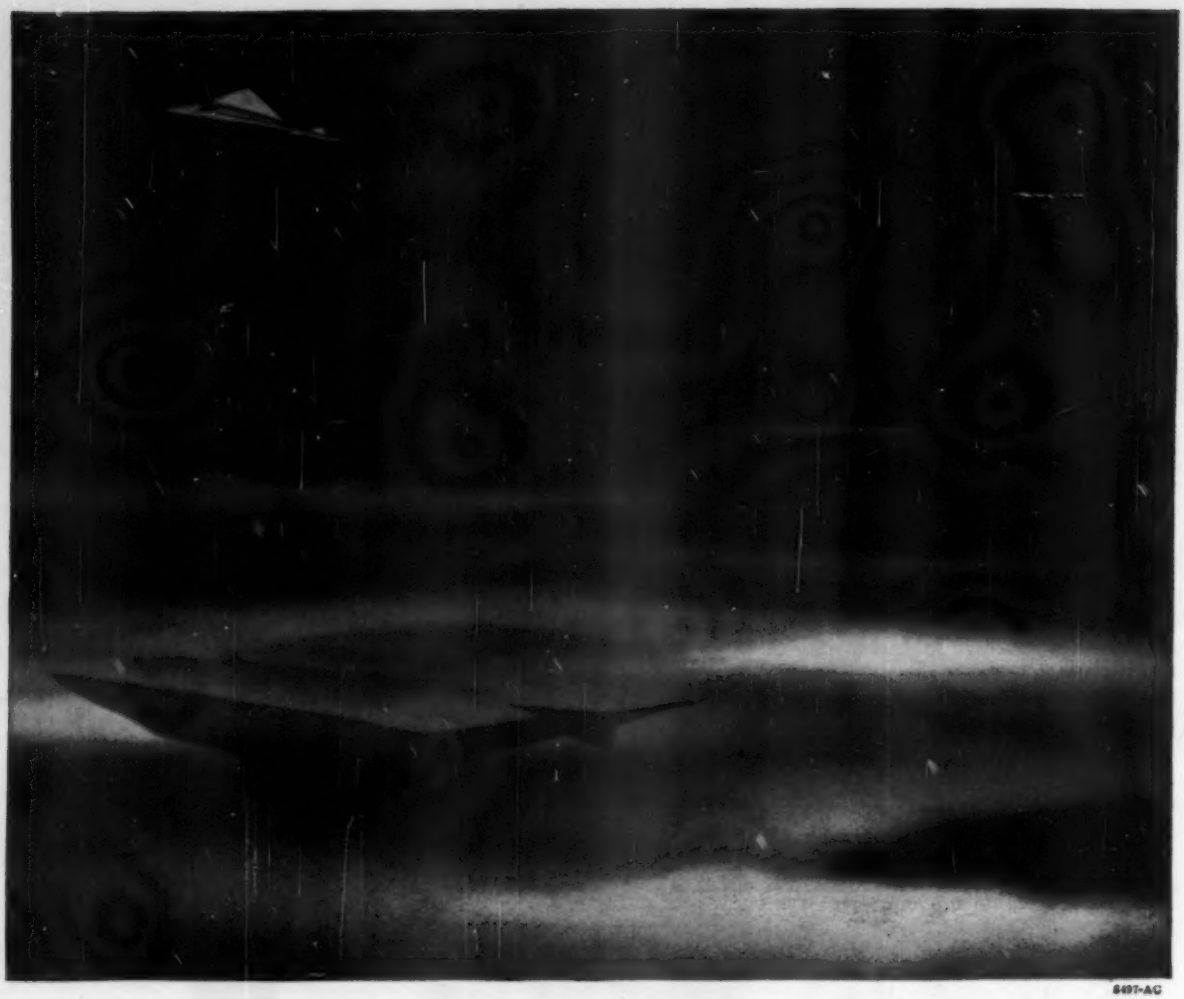
Professional opportunities in Southern California for engineers in these fields: Structures, Design, Welding, Bonded Structures, Liaison, Industrial. Men from Rohr will soon be conducting personal interviews in the following cities:

Akron	Chicago	New York
Baltimore	Cincinnati	Philadelphia
Buffalo	Dallas	St. Louis

Detailed resumes from qualified applicants will be held in confidence and given prompt attention in the arrangement of local interviews. Address J. L. Hobel, Industrial Relations Manager AW-1 Rohr Aircraft Corporation, Chula Vista, California.

ROHR

CHULA VISTA AND RIVERSIDE, CALIFORNIA



8497-AC

SPECIFICATION: AERONCA BRAZED HONEYCOMB STRUCTURES

DESTINATION: *MACH 3!*

To meet the critical demands of Mach 3 performance, new concepts in air vehicle structures have been evolved. Stainless steel honeycomb sandwiches, for example, are specified as major structural components in current weapons systems designed to operate in high mach environments.

Aeronca, a pioneer in the application of stainless honeycomb to air weapons, has developed advanced production methods and facilities under a proprietary research and development program. As a result, Aeronca is one of the few companies actually producing these high-temperature structures in quantity.

Aeronca is proud that its capabilities have been selected to support the North American B-70 and F-108 Weapons Systems.

AERONCA manufacturing corporation
1714 GERMANTOWN ROAD • MIDDLETOWN, OHIO

Expansion of our operations has created openings for additional senior engineers. Write to L. C. Wolfe, Chief Engineer.

however, that interpretation is required.

The Navy officer cited an example of an external fuel tank for an aircraft. In this situation, the manufacturer was building them for the Navy at the quoted price of $2,200. When the item was going to be advertised for general bid, that same manufacturer's price came down to $1,700 per item. Low bid on the item was $1,100 and this later reduced in production to $800.

Saunders countered that the regulation is fuzzy, and open to interpretation, which does not equitably take care of all cases of proprietary rights.

In summary, Petrowitz explained there are two ways to solve the proprietary rights problems within existing regulations.

These, he said, are by direct payment by the government to the small businessmen for their proprietary rights or by licensing and royalty agreements which are necessary to retain the small businessman's incentive to do business with the government or any prime contractor in the defense complex. Second solution he posed was to spell out regulations on proprietary interests of small firms in items developed either with military funds, with company funds, or a combination, in which an attempt would be made to define almost all the circumstances generally which could occur.

In the session on military cost principles, it was noted that under current regulations, it is difficult to set accurate prices for items. Also, external pressures contribute substantially to the pricing structure.

In this, it was pointed out that the greatest pressures probably are exerted according to what method of doing business is used, i. e., either cost-plus-fixed-fee, or fixed price contract.

Under a cost-plus-fixed-fee, the contractor can make no extra profit regardless of the savings he may make, thus eliminating his incentive under this type of contract, possibly resulting in inflated costs. Under the other system, contractors by exerting ingenuity, may roll up very large profits.

WHO'S WHERE

(Continued from page 23)

Edward F. Phillippi, Jr., manager, West Coast Division of Military Electronic Operations, Allen B. Du Mont Laboratories, Inc., Los Angeles, Calif.

Richard V. Davis, manager of applications engineering, General Electric's Jet Engine Department, Evendale, Ohio.

Dr. Franz Fischer, staff scientist, Aircraft Equipment Division, Consolidated Diesel Electric Corp., Stamford, Conn.

Robert O. Vaughan, manager, newly established Western Regional Government Operations Office, Los Angeles, Calif., of Dresser Industries, Inc.

William D. Korli, general manager, Kurz and Root, Pacific Division, Inc., Burbank, Calif. **Also: C. Moreno**, supervisor-operations; **K. A. Moll**, material control manager.

Charles M. Volkland, sales manager, Sierra Electronic Corp., a subsidiary of Philco Corp., Menlo Park, Calif.

Don Kundinger, manager-sales and contracts, Hydrodyne Corp., Los Angeles, Calif.

Kartar Dhanjal, senior electronics engineer, Epsco-West, Anaheim, Calif.

Changes

James T. Harker, assistant director of marketing, Grand Central Rocket Co., Redlands, Calif.

General Electric's Production Engine Department, Cincinnati, Ohio, has appointed **John W. Bergman**, resident managing engineer-Germany, to assist the Federal Republic of Germany in the licensed manufacture of GE's J79 turbojet engine.

James R. Dunn, manager, and **Morton Goldman**, associate manager, Liquid Rocket Engines Department, Propulsion Laboratory, Space Technology Laboratories, Inc., Los Angeles, Calif. **Also: Dr. Joseph G. Logan**, manager, Propulsion Research Department, and **Dr. C. J. Wang**, manager, Propulsion Systems and Development Department.

Tactical Weapon Systems Division of Aeronutronic Systems, Inc., Ford Motor Co. subsidiary, Maywood, Calif., has appointed the following managers: **Herbert K. Weiss**, advanced systems development; **Louis H. Brennwald**, systems test and prototype fabrication; **John F. Cooney**, administration.

Fred Hittman, head of the newly established PM-1 Product Department of the Nuclear Division of The Martin Co., Baltimore, Md. **Dr. Franklin G. Myers** succeeds Mr. Hittman as head of the Nuclear Division's Reactor Systems Department; **Joseph V. Loppert** succeeds Dr. Myers as operations manager of the Nuclear Division.

Garret E. Wright, manager of special computer sales, Lockheed Electronics and Avionics Division, Los Angeles, Calif.

Arnold R. Anchordoguy, program director-Thor weapon system, Space Technology Laboratories, Inc., Los Angeles, Calif.

Herman Reich, manager-advanced Navy projects, and **George W. Hart**, manager of marketing-administration and personnel development, General Electric's Light Military Electronics Department, Utica, N. Y.

Wouter Van de Bunt, manager of long range planning, Capital Airlines, Inc.

California Technical Industries Division of Textron, Inc., Belmont, Calif., has appointed the following engineering supervisors: **Terrence Taylor**-altitude and three-axis flight simulators; **Joseph Suarez**-automatic circuit and component testing devices; **Charles Kruse**-microwave instrumentation, including radome and antenna testing systems.

Kenneth H. DeRoche, contract manager, and **Samuel H. Cantwell**, manager-administration, Missile Development Laboratory of Minneapolis-Honeywell Regulator Co., West Los Angeles, Calif.

Kenneth T. Kitchin, sales manager-commercial products, AC Spark Plug Division of General Motors, Milwaukee, Wisc.

David E. Lewis, assistant manager-applications engineering, BJ Electronics, Borg-Warner Corp., Santa Ana, Calif.

missile development

and test

GROUND ELECTRONICS

The continuing growth at Boeing of advanced weapon system and spacecraft programs affords exceptional opportunities for career growth and stimulating assignments in ground electronics equipment related to missile test and associated fields.

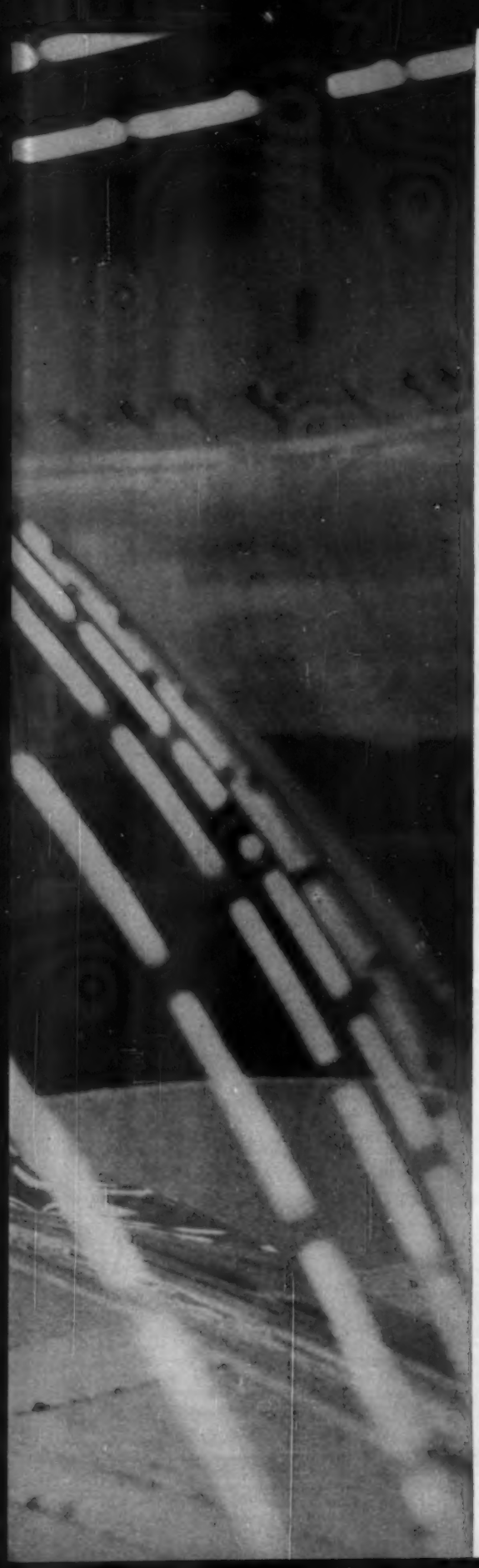
Rewarding openings are available in advanced equipment developmental areas of sub-system functional test, special sequence and monitoring, ground instrumentation, and calibration and certification. Other fields include auto and manual missile checkout, mobile launch site checkout, auxiliary power, launch sequence-monitor, and interconnecting cabling and cable junctions.

At Boeing, you'll be backed by the industry's most extensive, varied and complete research facilities. If your engineering or scientific background qualifies you in any of the above categories, and you're interested in a working environment that provides all the scope and challenge you need, drop a line *now* to:

Mr. Stanley M. Little
P. O. Box 3822-AVI
Boeing Airplane Company
Seattle 24, Washington

BOEING

...environment for dynamic career growth



BASIC TEST FOR MEDIA SELECTION:

Ask anyone, anyone you're trying to sell in the aviation market, what publication he reads and respects most.

A powerful editorial force is a powerful selling force.

Aviation Week

Including **Space Technology**

A McGraw-Hill Publication, 330 West 42nd St., New York 36, N. Y.

Aviation's largest engineering-management audience.

ABC PAID CIRCULATION 71,950

AIR TRAFFIC CONTROL – AIR DEFENSE INTEGRATION:

Project CHARM

One Example of the Pioneering Concepts Attracting Engineers & Scientists to

THE MITRE CORPORATION

Established only a year ago under the sponsorship of the Massachusetts Institute of Technology, MITRE, in its role as technical advisor to the USAF's Air Defense System Integration Division (ADSID), is pursuing an **active, experimental** program directed at coordinating and integrating the nation's evolving **air traffic system** with present and future **air defense systems.**

As an integral part of this long-term program MITRE has designed and implemented an experimental system called CHARM (CAA High Altitude Remote Monitor). Utilizing the Whirlwind computer with its associated display and input-output system and parts of the MITRE-operated radar network (covering most of New England) the system is being operated with the cooperation of the Boston Air Route Traffic Control Center and is being used to evaluate:

- **Joint use of data sources, computers and communication links**
- **Data transfer methods between the two systems**
- **Increased capabilities for both systems through utilization of advanced computer technology**

The test vehicle CHARM is to be replaced by a more sophisticated system using advanced technology with improved computers and data processing equipment.

For engineers and scientists with an interest in air traffic control and its related problems there are important positions in:

System Design • System Engineering

Communications Planning • System Test & Evaluation

Real-Time Computer Programming

Conveniently located in suburban Boston, MITRE's modern research facilities include fully equipped electronics laboratories and two large-scale, high-speed digital computers – the IBM 704 and an experimental SAGE AN/FSQ-7. These machines will soon be augmented by an IBM 7090 and a solid state SAGE computer.

To arrange a confidential interview,
please send resume to Dana N. Burdette, Professional Personnel Director

THE MITRE CORPORATION
244 Wood Street – Lexington 73, Massachusetts

ELECTRONICS ENGINEERS

ELECTRONIC ENGINEERS

Positions open require personnel with B.S. or equivalent, M.S., Ph.D. and 0 to 10 years of related experience.

Assignments in the following areas:

ANTENNA DESIGN
DYNAMICS
ELECTRONIC DESIGN
ELECTRONIC WRITING
OPERATION ANALYSIS and RESEARCH
PRELIMINARY DESIGN
RADOME DESIGN
SUSTAINING

PHYSICISTS

Positions open require personnel with M.S. or Ph.D. and 3 to 10 years experience.

...CAN YOU IGNORE THIS OPPORTUNITY?

INTERVIEWS WILL BE HELD IN THESE AND OTHER CITIES IN THE NEAR FUTURE:

DETROIT • ROYAL OAK • NEW YORK • CHICAGO • WASHINGTON • ST. LOUIS • GARDEN CITY • BALTIMORE • INDIANAPOLIS • FT. WAYNE
MINNEAPOLIS • DAYTON • CINCINNATI • DENVER • MILWAUKEE • PHILADELPHIA • BOSTON • SALT LAKE CITY • CLEVELAND

CONVAIR-POMONA

Home of the successful Terrier and Tartar Missiles in SOUTHERN CALIFORNIA

Engineers discover maximum career stability and unlimited individual growth here at CONVAIR-POMONA, America's first fully integrated missile plant, engaged in research, development and production of missiles and highly advanced (still classified) weapons systems.

The excellent location of this modern air-conditioned plant offers unsurpassed living conditions. Suburban Pomona is only thirty minutes from Los Angeles and Hollywood and in close proximity to many recreational centers; the mountains, desert and ocean. Convair-Pomona is ideal for personal achievement and is within America's finest year-round living climate.

Forward resume at once, so arrangements for your personal interview can be made. Write to Mr. B. L. Dixon, Engineering Personnel Administrator, Dept. 12-A
Relocation expenses paid to qualified applicants.

CONVAIR/POMONA
a Division of
GENERAL DYNAMICS
CORPORATION
POMONA, CALIFORNIA

Aeronautical wind tunnel
located at University of Michigan

FOR A SCIENTIFIC CLIMATE...

There's a devotion to creative thinking that you sense the minute you walk through the front door of the Bendix Systems Division.

Located in Ann Arbor, Michigan —a university town with big city advantages—you may enjoy all four seasons to the fullest. The year-round sports and outdoor recreation mean fun for you and your family. Within the buildings that house the Bendix Systems Division, the climate is scientific all year 'round.

If you are an able engineer or scientist seeking to apply your imagination and ingenuity to the problems involved in developing new weapons systems, you will enjoy the scientific climate at Bendix Systems Division.

If you are interested in doing advanced study, you will find the University of Michigan's fine Engineering College next door. Bendix encourages you to take advantage of this opportunity by attending daytime classes.

For information on a career in systems research and development, as well as a better way of life, you are invited to write for our new recruitment brochure. Bendix Systems Division, Dept. A6-8, Ann Arbor, Michigan.

Bendix Systems Division
ANN ARBOR, MICHIGAN

Bendix
AVIATION CORPORATION

Achievement in Action at **Avco . . . for**

SCIENTISTS AND ENGINEERS

Achievement is habit at Avco! A leader in the field of atmospheric re-entry, Avco is now providing significant contributions to basic and applied research in Space and Missile Technology.

Supervisory, Senior and Junior positions are available in these areas:

- **ELECTRONICS**
- **MATHEMATICS**
- **PHYSICS**
- **CHEMISTRY**
- **MATERIALS**
- **FLIGHT TEST ENGINEERING**
- **DESIGN ENGINEERING**
- **PRODUCT ENGINEERING**
- **AERODYNAMICS**
- **APPLIED MECHANICS**
- **THERMODYNAMICS AND AND HEAT TRANSFER**

Attractive working environment outside of metropolitan Boston. The large, fully equipped, modern laboratory is close to Boston educational institutions and cultural events. The division offers a liberal educational assistance program for advanced study.

Forward your inquiry to:
Dr. R. W. Johnston
Scientific and Technical Relations,
Dept. AW6

AVCO
Research & Advanced Development
201 Lowell St., Wilmington, Mass.

ENGINEERS
AND
SCIENTISTS

Here is your opportunity to grow with a young, expanding subsidiary of the Ford Motor Company. Outstanding career opportunities are open in Aeronutronic's new RESEARCH CENTER, overlooking the Pacific at Newport Beach, and the facility in Glendale, California. You will have all the advantages of a stimulating mental environment, working with advanced equipment in a new facility, located where you can enjoy California living at its finest.

PhD and MS RESEARCH SPECIALISTS with 5 to 7 years' experience in heat transfer, fluid mechanics, thermodynamics, combustion and chemical kinetics, and thermoelasticity. To work on theoretical and experimental programs related to re-entry technology and advanced rocket propulsion. Specific assignments are open in re-entry body design, high temperature materials studies, boundary layer heat transfer with chemical reaction, thermal stress analysis, and high temperature thermodynamics.

PROPULSION ENGINEERS with 5 years' experience in liquid and solid rocket design and test. Familiarity with heat transfer problems in engines desirable. To work on program of wide scope in R & D of advanced concepts in rocket engine components, and for missile project work.

APPLIED MATHEMATICIANS. 3-5 years recent experience required and A.B. or M.A. degree. Experience in numerical analysis and computer work in connection with rockets and rocket propellants.

STRESS HIGH TEMPERATURE MATERIALS. Mechanical or Metallurgical Engineer, must be familiar with thermal stress and shock as well as elasticity and plasticity. Application to nose cones and thrust chambers.

FLIGHT TEST & INSTRUMENTATION ENGINEERS with 5 to 10 years' experience in laboratory and flight test instrumentation techniques. Will develop techniques utilizing advanced instrumentation associated with space vehicles.

THEORETICAL AEROTHERMODYNAMICIST. Advanced degree and at least 5 years' experience in high-speed aerodynamics. Knowledge of viscid and inviscid gas flows required. To work on program leading to advanced missile configurations. Work involves analysis of the re-entry of hypersonic missiles and space craft for determining optimum configuration.

CERAMIST, M.S. or PhD. required and 3-5 years recent experience with high temperature materials, structures and cermets.

ENGINEER or PHYSICIST. With experience in the use of scientific instruments for making physical measurement. Work related to flight test and facility instrumentation. Advanced degree desired with minimum of 3 years of related experience.

Qualified applicants are invited to send resumes and inquiries to Mr. R. W. Speich, Aeronutronic Systems, Inc.

SPACE TECHNOLOGY DIV.

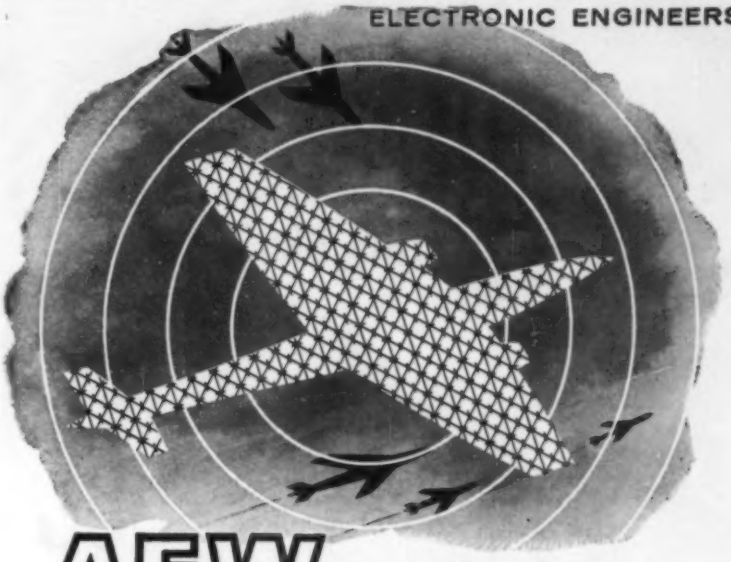
AERONUTRONIC

a subsidiary of Ford Motor Company

Bldg. 12, P.O. Box 697, Newport Beach, Calif.

Newport Beach, Glendale, Santa Ana, and Maywood, California

ELECTRONIC ENGINEERS



AEW with the automated voice of command....

ANOTHER OF THE MANY ADVANCED PROJECTS ATTRACTING ENGINEERS TO GENERAL ELECTRIC'S LIGHT MILITARY ELECTRONICS DEPARTMENT

Light Military is developing a new concept in Airborne Early Warning and Control which will provide protection for a mobile unit by detecting enemy aircraft at unprecedented ranges, tracking, adapting itself to changing combat situations, and transmitting tactical data *automatically* to combat information centers. The system will match a 3-Dimensional radar with novel correlation techniques and an automated data handling system which – for the first time – will practically eliminate Man from the control loop.

AT LIGHT MILITARY CAREER OPPORTUNITY SPANS THE EM SPECTRUM – FROM AUDIO TO INFRARED

Automated AEW is but one of the many advanced programs you will find at Light Military. Projects such as Polaris Fire Control and Guidance Computers, ICBM Atlas Guidance, Airborne ECM, and Airborne Navigation Systems offer creative engineers and scientists unmatched opportunities to apply imaginative and novel approaches toward resolving formidable engineering problems. There are immediate openings in these areas:

- CIRCUIT DESIGN
- MICROWAVE DEVICES
- IF AMPLIFIERS
- RADAR RECEIVERS & TRANSMITTERS
- DISPLAY DEVICES & VIDEO INDICATORS
- SERVOMECHANISMS
- TRANSISTOR CIRCUITRY
- TRAVELLING WAVE TUBES
- AERODYNAMICS
- DATA PROCESSING & DIGITAL TECHNIQUES
- INFRARED
- VIBRATION & SHOCK

Forward an outline of your experience or your resume in strict confidence to: Mr. W. Gilmore, Dept. 64WW

LMED

LIGHT MILITARY ELECTRONICS DEPARTMENT

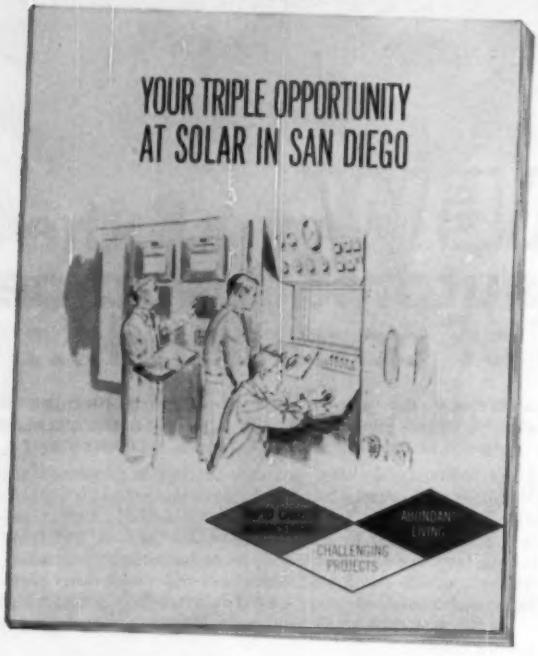
GENERAL ELECTRIC

FRENCH ROAD, UTICA, NEW YORK

ENGINEERS

experienced in missile and gas turbine fields

SEND FOR THIS BROCHURE



GET THE FACTS about Solar and your *triple opportunity* – and do it without delay.

Opportunity #1: The chance to get in on the ground floor and gain a key creative position with tremendous potential. Solar is humming with exciting and challenging programs. Solar's Missile and Space Group has several highly advanced projects under way, including a new ARPA Project involving a completely new anti-missile defense system. Many openings also exist in Solar's fast-moving gas turbine programs.

Opportunity #2: You don't get lost in the crowd! Solar is a medium-sized company (2500 people in San Diego) with a successful history since 1927. Personnel policies are advanced. Salary and performance reviewed semi-annually. Liberal relocation allowances. Professional status of engineers is fully appreciated and recognized. A new 60,000 sq. ft. engineering building, necessitated by expanding research and development, will be completed in 1959 on the edge of San Diego Bay.

Opportunity #3: The chance to live better in sunny San Diego. This famous resort area has the finest year-around climate in the U.S. Recreational, cultural and educational facilities are excellent. You and your family will enjoy life more at Solar in San Diego.

Send for brochure giving complete details. Write to Louis Klein, Dept. E-604, Solar Aircraft Company, 2200 Pacific Highway, San Diego 12, Calif. Why not send along your resume of qualifications to save time?

SOLAR
AIRCRAFT COMPANY
SAN DIEGO
DES MOINES

WHERE TO BUY

A. B. MURRAY CO. INC.
EST. 1945
AIRCRAFT
STAINLESS STEEL
TUBING FROM STOCK
Elizabeth, N. J. • Bristol, Pa. • McKeesport, Pa.

FOR ADDITIONAL INFORMATION

About Classified Advertising,

Contact The McGraw-Hill Office Nearest You.

ATLANTA, 3
1301 Rhodes-Haverty Bldg.
JAckson 3-6951
R. POWELL

BOSTON, 16—350 Park Square
HUbbard 2-7160
D. J. CASSIDY

CHICAGO, 11
520 No. Michigan Ave.
MOhawk 4-5800
W. HIGGENS—E. S. MOORE

CLEVELAND, 13
1164 Illuminating Bldg.
SUperior 1-7000
W. B. SULLIVAN—T. H. HUNTER

DALLAS, 2—1712 Commerce St., Vaughan Bldg.
Riverside 7-5117
GORDON JONES—F. E. HOLLAND

DETROIT, 26—856 Penobscot Bldg.
WOodward 2-1793
D. M. WATSON

LOS ANGELES, 17—1125 W. 6th St.
HUntley 2-5450
P. M. BUTTS

NEW YORK, 36—500 Fifth Ave.
OXford 5-5959
H. T. BUCHANAN—R. P. LAWLESS

PHILADELPHIA, 3
Six Penn Center Plaza
LOcust 8-4330
H. W. BOZARTH—T. W. McCLURE

ST. LOUIS, 8—3615 Olive St.
JEfferson 5-4867

SAN FRANCISCO, 4—68 Post St.
DOuglas 2-4600
S. HUBBARD

Proposal Representatives

Large military electronics company has exceptional openings for mature men with appropriate experience. You will participate in proposal preparation, perform both proposal and general liaison functions and be an information source. Positions open are in Los Angeles, Dayton and Washington, D.C. Five to ten years' experience representing industry to government procurement agencies is required. BSEE desirable.

Please send detailed resume to:

P-1772, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

ADDRESS BOX NO. REPLIES TO: Box No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. BOX 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 4: 68 Post St.

POSITION VACANT

Helicopter—Pilots and Mechanics. Leading Company needs pilots with a minimum of 750 Helicopters hours. Also licensed A & P's with Helicopter Maintenance experience. For full information write Rotor-Aids, Inc., P. O. Box 1850, Ventura, California.

POSITIONS WANTED

Senior Aeronautical Engineer-Airline Transport Pilot extensive heavy multi engine and extensive flight experience desires flying position that requires technical background. PW-1751, Aviation Week.

Aero Engineer seeks long term European sales/service position. Fourteen years military and civil aviation, last six in jet aircraft field service including transport. B.S. Aero, A & E, S&MEL. PW-1770, Aviation Week.

Mechanical Engineer seeks to join Manufacturers Representative organization as sales engr. BSME, age 32, ten years exper. including aircraft and field engrg., New England area preferred but will relocate. PW-1841, Aviation Week.

SELLING OPPORTUNITY WANTED

Sales Representative, Middle West/Aircraft, Missile. 10 years background. Desires to represent Sheet Metal Fabricator and Ridgid Tube Co. RA-1790, Aviation Week.

DON'T FORGET

the box number when answering advertisements. It is the only way we can identify the advertiser to whom you are writing.

THE MOST IMPORTANT NEWS FOR MECHANICAL DESIGN ENGINEERS TODAY:

308* CAREER POSITIONS OPEN AT GENERAL ELECTRIC'S NEW FLIGHT PROPULSION DIVISION

**(44 to be filled each month for 7 months)*

It's not just the high number of new jobs open at FPD—but the diversity of the opportunities *within one organization* that's important to your future.

You'll find assignments here in Research, Development, Final Design, Production and Test of almost any type of advanced flight propulsion system.

The project range is as broad as the industry, as the list at the right demonstrates. ▶

Equally important to you is the strong sense of obligation we feel at FPD to give each engineer who joins us the maximum opportunity to develop himself professionally. One of the ways we apply this philosophy is to match—and re-match assignments with a man's abilities and interests, as his career progresses.

Most current positions require background in turbomachinery D&D; some do not.

(There are also opportunities at Managerial and Specialist levels for Aerodynamicists, EEs, ChEs, Metallurgists, Physicists and Mathematicians.)

For more information about Flight Propulsion Division—and the professional and living advantages of the new Cincinnati, with its fine, uncrowded schools, some 30 active engineering societies, famous symphony orchestra . . . write for illustrated brochures #50 and #51. *For immediate placement consideration enclose your resume.*

A Partial List of
DIVISION-WIDE PROJECTS AT FPD

. . . CJ 805 aft fan engine to power Convair 600—**Commercial Engine Dept.**

. . . J79, famous powerplant of many applications, including F-104A—**Production Engine Dept.**

. . . J93 development engine with Mach 3 capability, will power B-70 & F-108—**Jet Engine Dept.**

. . . A well-advanced VTOL project for vertical and horizontal flight of a fixed wing aircraft . . . exotic propulsion systems using plasma and ion power sources—**Flight Propulsion Laboratory Dept.**

ALSO: High Mach, high energy powerplant in early development . . . a turboshaft project . . . **and other classified programs of unusual interest, with both commercial and military applications.**

Immediate Openings in these Areas

Basic Powerplant Design—Turbomachinery aero • nozzle design • reliability • performance & cycle analysis • installations/applications • component design.

Accessory & Control Systems—Electrical component design • mechanical component design • servomechanisms • reliability.

Test, Evaluation & Manufacturing—Test facilities engineering • aerodynamic instrumentation • manufacturing engineering • controls test equipment design.

Address Dr. Mark Peters, Bldg. 100, Dept. 64-WW
FLIGHT PROPULSION DIVISION

GENERAL ELECTRIC

Cincinnati 15, Ohio

CLASSIFIED

SEARCHLIGHT SECTION

ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

DISPLAYED RATE:

The advertising rate is $31.00 per inch for all advertising appearing on other than on contract basis. Contract rates on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE:

$2.70 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS, $2.70 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

Send NEW Ads or Inquiries to Classified Adv. Div. of Aviation Week, P. O. Box 12, N. Y. 36, N. Y.

BARGAINS! BELOW WHOLESALE!

FROM
THE HANGAR OF
FREDERICK B. AYER & ASSOCIATES, INC.

C-47 Low time since airframe overhaul—Zero time power.

Executive Ventura Gorgeous new Horton & Horton interior — Unequalled anywhere.

2 Grumman Geese One zero time throughout — Like new with new plane warranty.

de Havilland Dove 6-8 place executive model — Exceptional lease terms.

Grumman Widgeons 3 G44A Model — Ranger engines or Custom McKinnon — Hickman Conversion.

Military Surplus SNJ-7 PBY-5A Sensational prices — Flyable with ferry permit.

Hangars, Too! 120 x 200 all steel clear span hangar with 28 ft. headroom. Also 20 ft. wide 2-story shacks. Substantial piece of real estate. Great value.

Beechcraft C18S Top quality — Excellent value — Easy terms.

Our extensive Convair program enables you to buy these excellent aircraft substantially below our cost. For immediate details on the purchase, lease or financing of any of these fine planes, call:

FBA

Mr. Anthony Ming
FREDERICK B. AYER & ASSOCIATES, INC.
250 Park Avenue, New York 17, N. Y.
MUrray Hill 7-1800

WORLD WIDE AIRCRAFT DEALER

FOR SALE

Basic Components of Sperry Compass System

Type C-4 (U.S.A.F. Type J-2)

- **Gyro Directional Control Type S-3A** Sperry No. 673447
- **Amplifier, Type A-2** Sperry No. 653278
- **Flux Valve, Type C-2** Sperry No. 664543
- **Compensator, Sperry No. 656767**

40% discount from usual net price.

Also, Sperry A-4 Gun sights available for immediate delivery.

AIR COMPASS, INC.
P. O. Box 695-A, Rochester, N. Y.
Write, wire or phone collect
BEverly 5-2049

R-2800 CB16 — Sale Overhaul — ENGINE WORKS — LAMBERT FIELD ST. LOUIS — R-2800 CB16

Brand new 12 volt Lear LTRA-6's with omnimeter, 7 crystals and whistle stop tuning. $495.00 plus installation.

Brand new 24 volt Lear LTTR-6's less crystals. $249.00. Add $7.50 each for crystals.

Brand new LTTR-6's with omnimeter, whistle stop tuning. $324.00 plus installation.

Convert your Lear omniscope to omnimeter for $275.00, plus installation.

Brand new 24 volt LVTR-36. $450.00 plus installation.

New Dare R89 glide slope with shock-mount plugs and crystals. $219.00 plus installation.

WALSTON AVIATION, INC.
Box 271, E. Alton, Illinois
Phone P-6437

C-47'S FOR SALE DC-3'S

ALSO

REPAIR OVERHAUL MODIFICATION

VOLITAN AVIATION INC.
12820 Pierce St. Pacoima, Calif.
Phone EM-8-1283

OXYGEN EQUIPMENT

SALES & SERVICE

REGULATORS — MASKS — VALVES
PORTABLES & CYLINDERS
FIXED INSTALLATIONS
GOV'T. APPROVED REPAIR STATION

ZEP AERO Phone: ORegon 8-1161 EL SEGUNDO, CALIFORNIA

FINEST AIRCRAFT MAINTENANCE

Twin Beech - DC-3 - Lodestar

CAA Approved Repair Station #3864
Class 1 & 3 No Limitations

SINCE 1937 **Page AIRWAYS INC.**
ROCHESTER AIRPORT
PHONE: FAirview 8-2720
ROCHESTER 11, N.Y.

RADAR

AUTOMATIC PILOTS, NAVIGATION & COMMUNICATION SYSTEMS

Collins, Bendix, Sperry, Lear, ARC, Wilcox

Pittsburgh Institute of Aeronautics
Graduates—Instructors—Associates
Reunion

For Details Contact

PITTSBURGH INSTITUTE OF AERONAUTICS
P. O. Box 10897
Pittsburgh 36, Pennsylvania

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, JUNE 8, 1959

AERONCA MANUFACTURING CORP. 110
AIRWORK CORP. 89
ALLISON DIV., G. M. CORP. 17
AMERICAN BOSCH ARMA CORP. 66
AMPEX CORP. 51
AMPHENOL-BORG ELECTRONICS CORP. 83
SIR ARMSTRONG-WHITWORTH AIRCRAFT LTD. 46
AVIATION WEEK INCLUDING SPACE TECHNOLOGY 112-113

BELL HELICOPTER CORP. 98
B & H INSTUMENT CO., INC. 103
BIRDAIR STRUCTURES, INC. 14
BOEING AIRPLANE CO. 40, 111
BRUNSWICK-BALKE-COLLENDER CO. 88
BUSINESS WEEK 102

CANADAIR LIMITED 48-49
CHANCE VOUGHT AIRCRAFT, INC. 92-93
COLE ELECTRIC CO. 78
COLLINS RADIO CO. 42
CONVAIR DIV. GEN. DYNAMICS CORP. 115

DAYSTROM TRANSICOIL CORP. 72
DYNAMETRICS CORP. 68

THOM. A. EDISON, INSTRUMENTS DIV. McGRAW-EDISON 22
ELECTRONIC ASSOCIATES 94-95
EX-CELL-O CORP., AIRC. DIV. 4

FAIRCHILD CONTROLS CORP. 5
FLIGHT REFUELING, INC. 6

GARRETT CORP. 106-107
GENERAL ELECTRIC CO. 8-9
GENERAL ELECTRIC CO., COMPUTER DEPT. 65
GILFILLAN BROTHERS, INC. 20
GOODYEAR AIRCRAFT CORP. 3

HALLICRAFTERS CO., THE 79
HILLER AIRCRAFT CORP. 16
HI-SHEAR RIVET TOOL CO. 11
HUGHES AIRCRAFT CO. 13, 80-81
HYDROMATICS, INC. 7

KOPPERS CO., INC. 104

LEACH CORP. ..... 3rd Cover, 70-71
LINDE CO., DIV. UNION CARBIDE CORP. CRYSTAL PRODUCTS 24
LISLE CORP. 67

MARLIN-ROCKWELL CORP. 10

NAPIER ENGINES, INC. 60
NICHOLS CO., W. H. 64
NORTH AMERICAN AVIATION 121
NORTHROP AIRCRAFT, INC., RADIOPLANE DIV. 96

PHILCO CORP., GOVERNMENT & INDUSTRIAL DIV. 12

RESISTOFLEX CORP. 82
ROHR AIRCRAFT CORP. 109
RYAN AERONAUTICAL CO. 18

SCHULZ TOOL & MFG. CO. 62-63
SCINTILLA DIV., BENDIX AVIA. CORP. 91
SERVOMECHANISMS, INC. ..... 4th Cover
SHELL OIL CO. 100-101
SOLAR AIRCRAFT CO. 90
STROMBERG-CARLSON ELECTRONICS 58

TELECOMPUTING CORP. 74
TEXAS INSTRUMENTS, INC. 54
THOMPSON FIBER GLASS CO., H. I. 76
TUBE METHODS, INC. 99

U. S. STEEL CORP. 108

VOI SHAN MFG. CO. ..... 2nd Cover

WESTINGHOUSE ELEC. CORP. DEFENSE PDTS. GROUP 86-87
WYANDOTTE CHEMICALS CORP., J. B. FORD DIV. 73
WYMAN-GORDON CO. 15

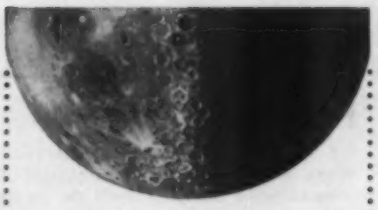
CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 114, 116-119
EDUCATIONAL Schools 120
EQUIPMENT (Used or Surplus New) For Sale 120
WHERE TO BUY A. B. Murray 118

ADVERTISERS INDEX

Aeronutronic Systems Inc. sub. of Ford Motor Co. ... 117
Air Compass, Inc. 120
Avco 116
Ayer & Assoc. Frederick B. 120
Bendix Systems Div. 116
Engine Works 120
General Electric 117, 119
Mitre Corp 114
Page Airways, Inc. 120
Pittsburgh Institute of Aeronautics 120
Rommert-Werner, Inc. 120
Solar Aircraft Company 118
Volitan Aviation, Inc. 120
Waiston Aviation, Inc. 120
Zep Aero 120



Help us solve the problems of

ION PROPULSION

Our Advanced Design Group is seeking engineers and scientists to work on low-thrust propulsion systems that will make possible the manned exploration of Outer Space. These are a few of the challenging positions:

Theoretical Physicist

Experienced in the field of particle physics, magneto-hydrodynamics and plasma physics, comparative performance of electrical propulsion systems, new methods of developing thrust from electrical propulsion systems, and direct conversion processes.

Chemical Physicists

To make studies on propellants for ion propulsion. Experienced in electronics, atomic physics, and physical chemistry.

Physicists

Primary activities will be in the field of ion sources and high vacuum techniques. Experienced in particle accelerators, ion sources, and electronics.

Electrical Engineer

Analysis of electrical power generators, preliminary stages designs of permanent magnet, AC induction and electrostatic generators.

Please write: Mr. H. F. Jamieson, Engineering Personnel Dept., 6633 Canoga Avenue, Canoga Park, Calif.

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION, INC.
FIRST WITH POWER FOR OUTER SPACE

LETTERS

Perfect Agreement

I have been informed that AVIATION WEEK is running my letter of April 15 complimenting the publication on running letters from pilots objecting to the editorial "Rewards and Responsibility" (AW Feb. 16) alongside Mr. Sayen's letter of May 7 canceling his subscription.

Presumably these are being run side by side under the respective headings of "Bouquets" and "Brickbats." It is difficult to comprehend what the belated use of my letter in conjunction with Mr. Sayen's is intended to prove—unless it is that he and I disagree concerning AVIATION WEEK's editorial policy.

We don't. As a matter of fact, we agree perfectly.

The letters were on two entirely different subjects. My letter was merely an expression of appreciation for opening your Letters to the Editor page to the many pilots who disagreed with you. Mr. Sayen's was an objection to the consistent way subjects pertaining to pilots are slanted in the news columns. I thoroughly concur with Mr. Sayen's opinion in this respect and can go back over story after story in issue after issue where it has occurred.

You have my permission to use this letter, if you wish.

ED MODES, DIRECTOR
Public Relations
Air Line Pilots Assn.
Chicago, Ill.

Lack of Responsibility

I have been a subscriber to your publication for several years. During this time I have found it reliable and in good taste.

However, the letter in the May 18 issue (p. 166) ending "Pan American Pilot" is a complete reversal of what I have come to expect in your publication. The first six paragraphs show a complete lack of responsibility on the part of whoever had the audacity to send them to a magazine for publication. Somehow that writer seems to realize this fact, evidenced by his not signing the thing. The rest of the letter should have been sent to the Internal Revenue Service.

I am of the opinion that you owe an apology (in print) to Capt. Sheehan and to Northeast Airlines for printing such a piece of space filler. You might also contact Pan American Pilot and have him (I presume) do the same.

MICHAEL P. MANGAN
Yonkers, N. Y.

Ordinarily I would not comment on Pan American Pilot's letter to you in the May 18 issue (p. 166), except he insists on bringing the 320 Northeast pilots into critical focus again. Answering his criticisms as simply as I can, I will reiterate parts of my first letter to you (Mar. 16, p. 122).

First, as to the "relative thing" check concept he and the other anonymous airline pilots he refers to, who have "loved ones," etc., are so shocked at, CAM No. 40 of the Civil Air Regulations states specifically what minimum requirements are to be met by a pilot in his six months check. Now company requirements, as in the case of Northeast Airlines, may actually be higher than those specified in CAM No. 40. Thus the "relative thing" concept. Whereas an FAA inspector may be satisfied by CAM No. 40, a Northeast check pilot may not be and will refer the pilot back to the training department to increase his proficiency.

As to Pan American Pilot's documenting his experience with Northeast Airlines—my guess is this man is one of the professional instructors hired by Pan American, who incidentally have an excellent training program, who is neither on their seniority list, does not fly the line and, in fact, does not have the experience of an active airline pilot. I believe he quite probably was looking for a job when he talked with Northeast's chief pilot and is probably disappointed at not having accomplished this.

However this may be, the best check pilot is one who at least a few months of the year flies the line in a command position and knows the realistic, every day "facts of life" of airline flying.

To sum up for Northeast Airlines—we have, in my opinion, one of the finest recurrent training programs in the industry; our check pilot standards are higher than those specified in CAM No. 40 and they fly the line themselves at least two months of the year.

As for myself, I have the utmost respect for the premise that an airline pilot should have or develop the highest sense of responsibility. To just glibly state this, however, is like saying there should be peace in the world—no one will disagree with you. If you're serious and want to help, give us decent and fair criticism and suggestions based on language and facts as they exist. If your editorial page is booked and can't be used, refer your suggestions to the Professional Standards Committee, Air Line Pilots Assn., Chicago, Ill.

Incidentally, I hope this Pan American Pilot finds a decent position instructing or checking somewhere.

CAPT. M. J. SHEEHAN
Northeast Airlines

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Fire Prevention

Although it appears as though there are fairly reliable systems for preventing or extinguishing fires in flight, it could be asked how many commercial airliners employ a reliable system (such as the one developed by NACA several years ago) for preventing fires in the event of crash landings.

EDWARD KRAMER
Glenshaw, Pa.

Soviet Trainer

We don't like to fall into the category with those who only write the Editor to chide him on little errors and discrepancies that inevitably occur now and then in any publication—but this one we can't resist. The "First Photo of Yak-18A Soviet Trainer" which you so proudly displayed on p. 145 of the May 18 issue is actually a Yak-18P. The Yak-18A is a two-place plane as you stated, but the Yak-18P shown in the photo is a single-seat version.

FRED PHILLIPS & JIM WEDDING
Arlington, Va.

Russian Information

The Soviet intelligence agents operating in the United States obtain over 85% of their information from U.S. magazines, newspapers, and various technical publications. We, on the other hand, are unable to gain any similar information from Russia. All Russian publications are controlled to the extent that nothing of an intelligence nature is available to U.S. agents.

To follow AVIATION WEEK's line of reasoning, this drastic censorship should stifle technical progress in Russia. Evidence indicates that this is not the case. Russia had the best fighter aircraft in Korea and presently has the best long-range rockets. Censorship has evidently not prevented an interchange of information within the Russian technical community. It has successfully prevented the U.S. from attaining any information of value from Russia. Thanks to the American news media, the Russians know everything we are doing and our defense planners must operate in a fog as a result of Russian censorship.

I, personally, am very proud that our government was able to keep Project Argus secret for a while. If it takes "deception, distortion and deliberate manipulation" then more power to them. The people in Washington are our elected representatives. They are patriotic Americans. They are sworn to defend us. If we can't trust them whom can we trust? If in their sober judgment something should remain secret, it is within their authority to keep it so.

There is not a shred of real evidence that the Russians knew about Project Argus. Naturally, when you ask Russian scientists they say they knew about it all the time. What else could a Russian scientist say?

We all know that the primary interest of U.S. news media is to make money. A secondary interest is to influence as many people as possible. This is power. What better way for persons outside the government to exercise power. Self-righteous statements about "duty to the public" are the real blanket of fog. I hope all of the irresponsible dealers in "news" sleep well at night considering the possible results of broadcasting information considered vital by our government leaders. Some of the rest of us consider the protection of this country our primary duty in war time; and make no mistake about it, we are at war.

JACK CALDWELL
Sunnyvale, Calif.

MOMENT OF DECISION

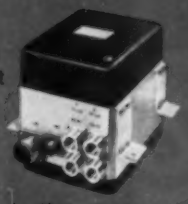
The German observer had stopped firing. Puzzled, the young American flew his Nieuport 28 in closer to the tail of the Rumpler for a good look at the situation. As he came within 50 feet of the enemy, he saw a strange sight.

(Continued on page 70)

©1959 LEACH CORPORATION

UNIVERSITY MICROFILM I
STEVENS RICE GS
313 N 1ST ST
ANN ARBOR MICH

ADVANCED FUEL MANAGEMENT ...FROM SMI



The requirements of accurately tanking missiles with propellants is but one of the areas of fuel management in which Servomechanisms, Inc. has demonstrated capability. *Propellant utilization* and *thrust control* are other areas in which SMI has developed highly accurate and precise measuring and control systems.

SMI's LOX Tanking Computer, which has been in production for the past year, accurately measures, controls and indicates the level of liquid oxygen in missile tanks. Loading is accomplished rapidly and accurately due to a unique two-mode control system. The first mode permits extremely high pumping rates until about 98% capacity is reached. The second mode then takes over and controls a precise proportioning valve which adds the necessary LOX to fill the tank within 0.1% accuracy. The second mode also provides continuous topping, thus compensating for LOX evaporation losses during standby.

SMI has currently in development, more advanced fuel management systems to meet the increasingly complex requirements of the next generation of missiles and spacecraft.

SMI would welcome the opportunity to discuss and propose solutions to your fuel management problems. Write for descriptive literature.

Positions are available for qualified engineers and scientists in the areas of:
Systems Synthesis and Analysis—Project Management—Qualification and Environmental Test Engineering—High Vacuum Deposition Techniques.

SERVOMECHANISMS SMI INC.

LOS ANGELES OPERATIONS: *12500 Aviation Blvd., Hawthorne, Calif.*
MECHATROL DIVISION: *Westbury, L. I., New York*
RESEARCH AND DEVELOPMENT CENTER: *Goleta, California*

The products of SMI are available in Canada and throughout the world through Servomechanisms (Canada) Limited, Toronto 15, Ontario